Aug. 13, 1968 W. LOVELAND ET AL Re. 26,440

AUTOMATIC CARTON CLOSING MACHINE

Original Filed Aug. 24, 1962

13 Sheets-Sheet 1

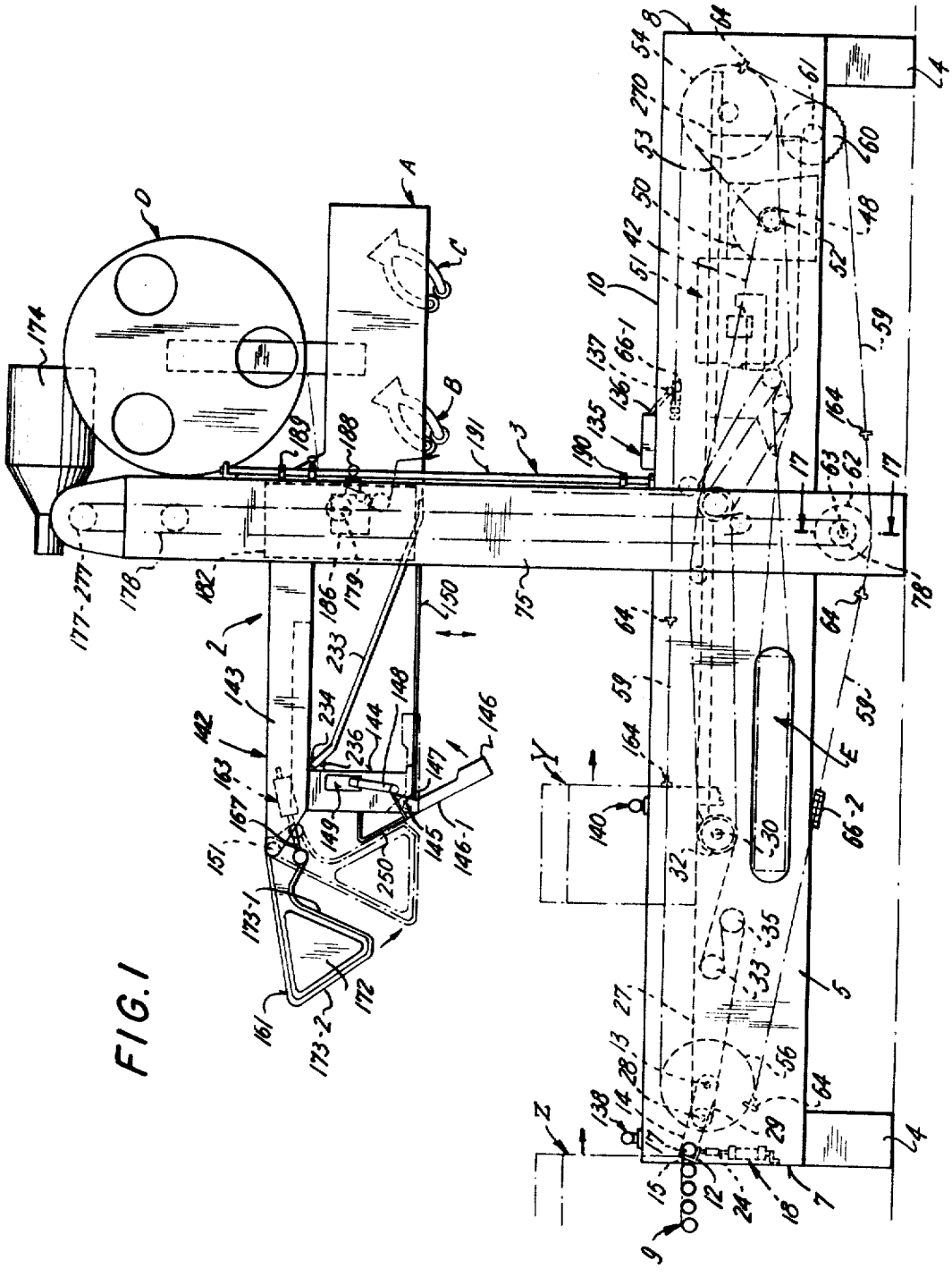


FIG. 1

AUTOMATIC CARTON CLOSING MACHINE

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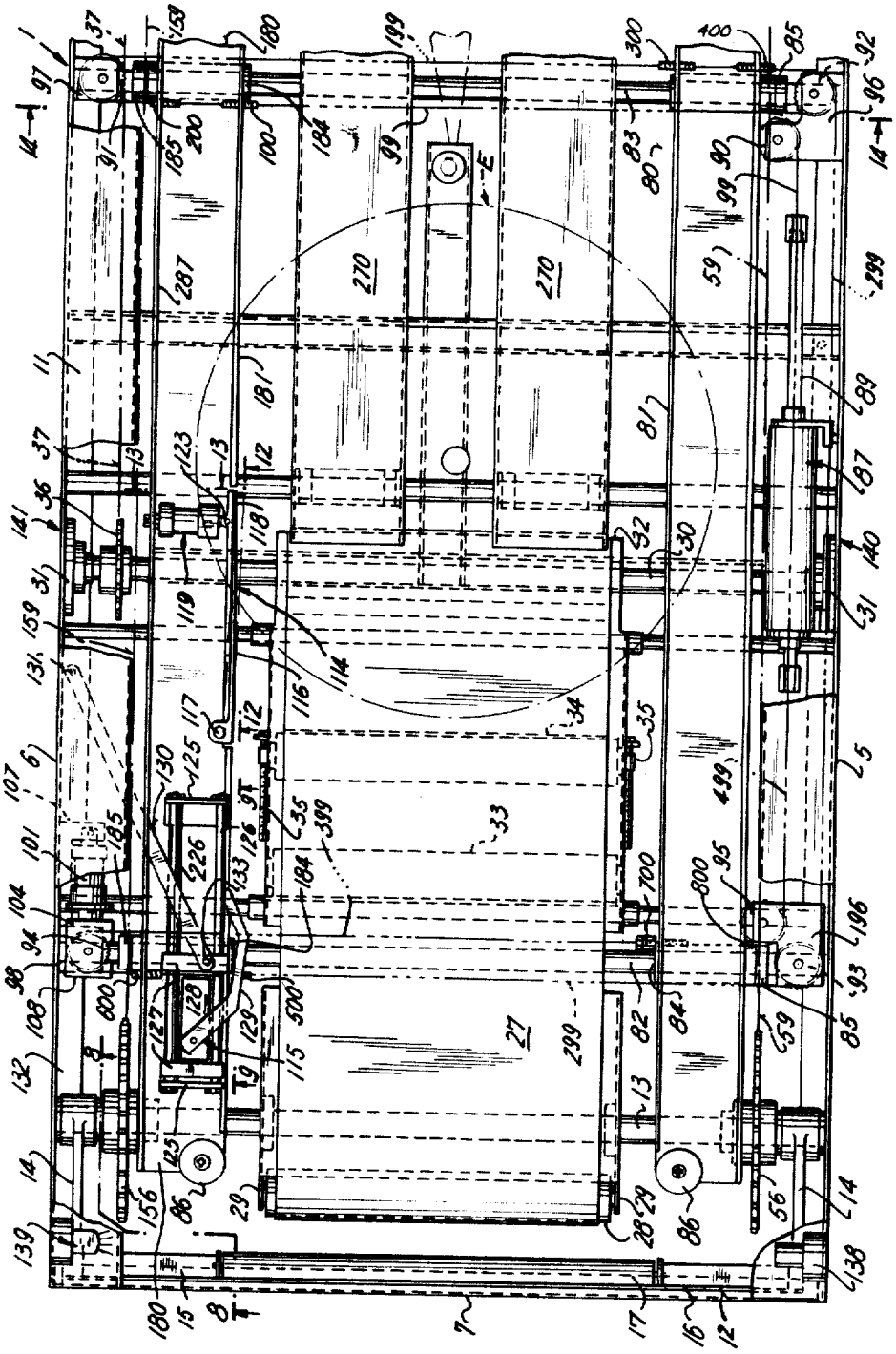


FIG. 2

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AUTOMATIC CARTON CLOSING MACHINE

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FIG. 3

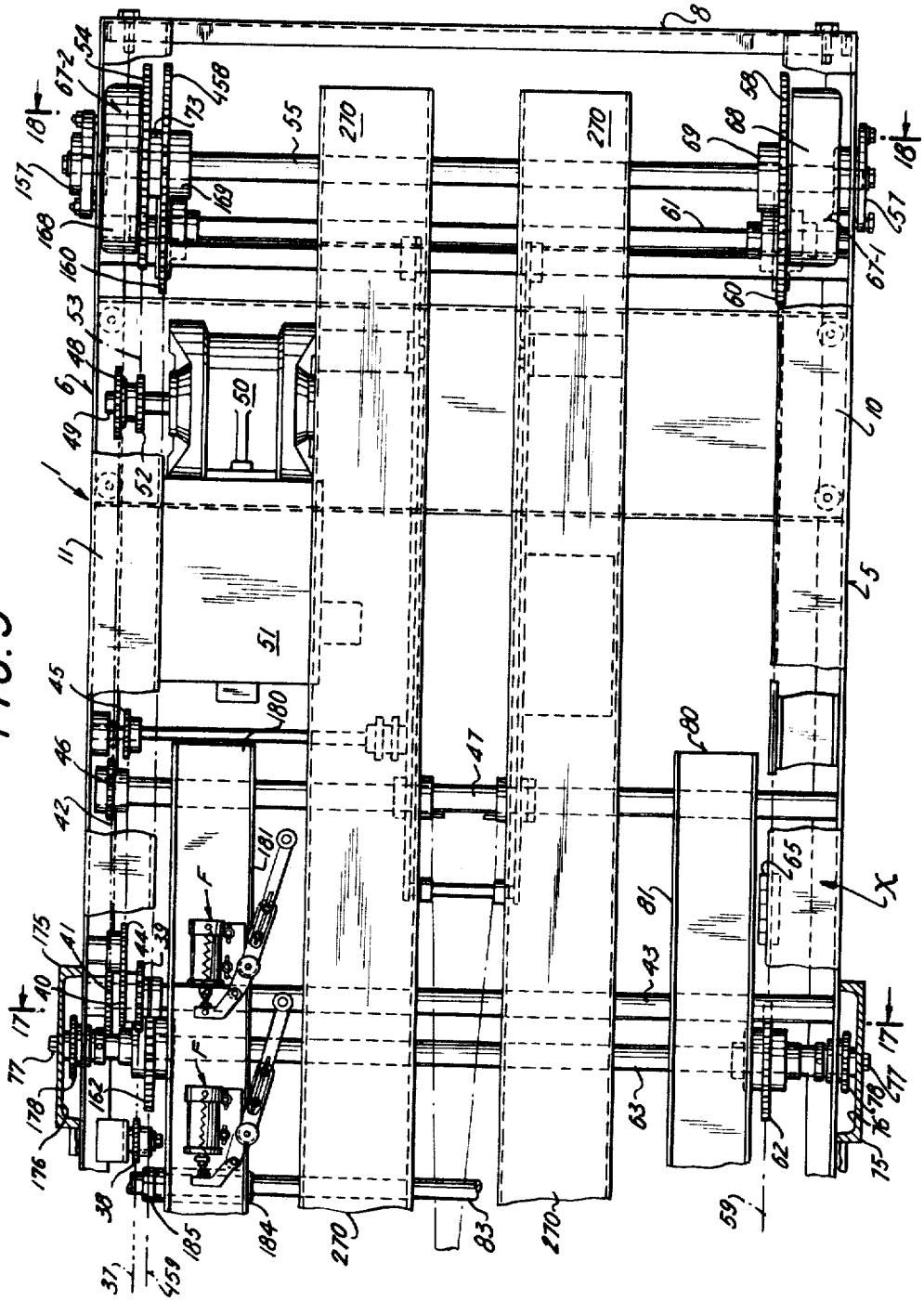
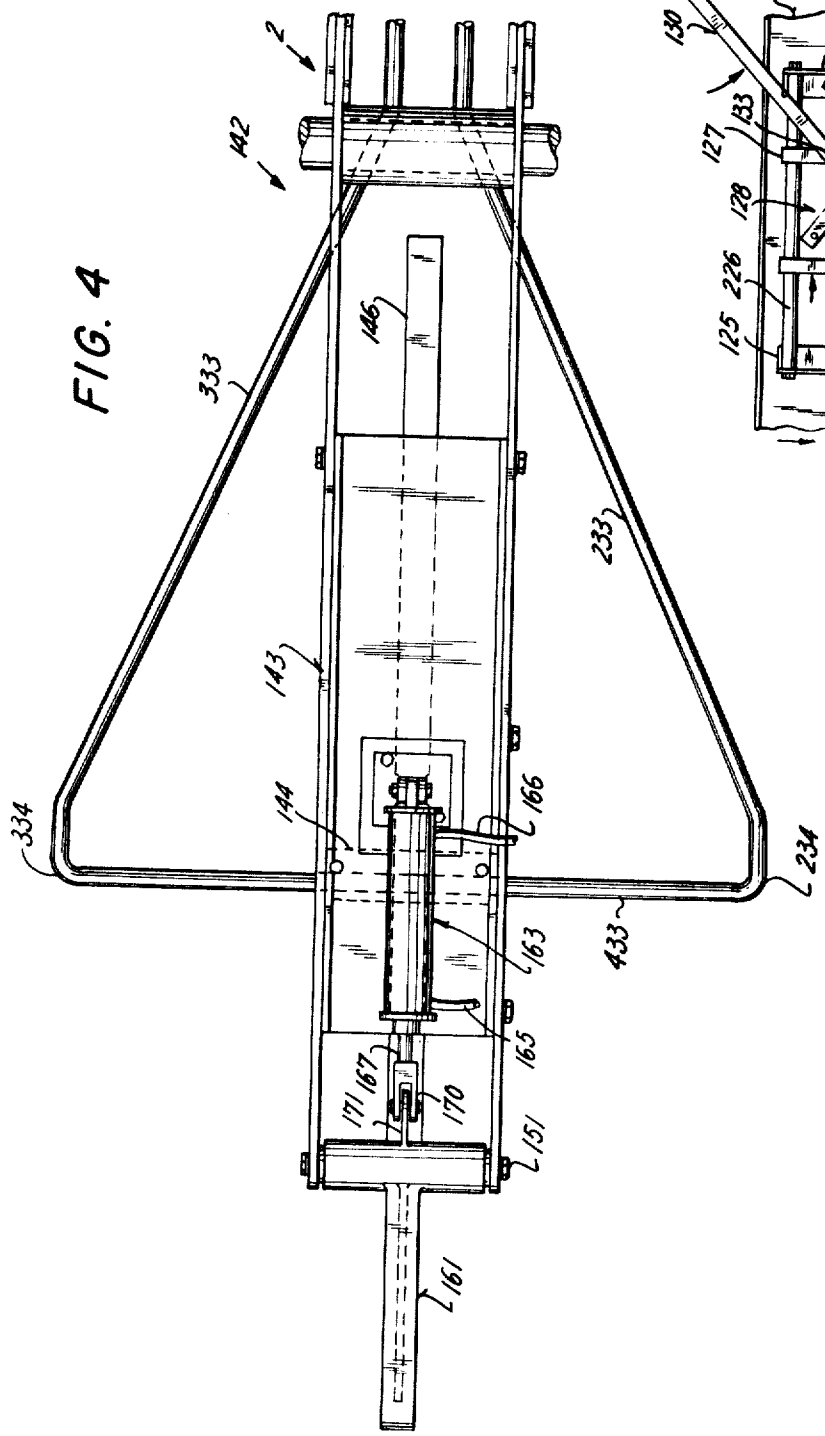


FIG. 4


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FIG. 11

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FIG. 5

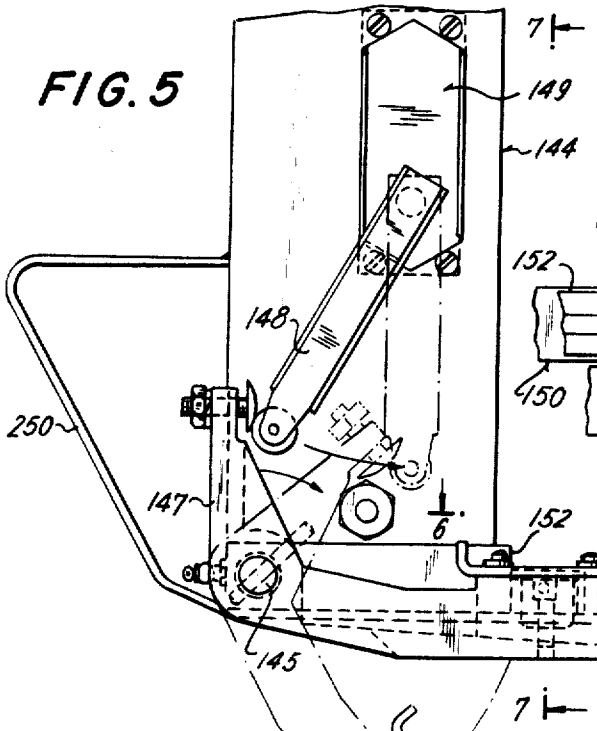


FIG. 6

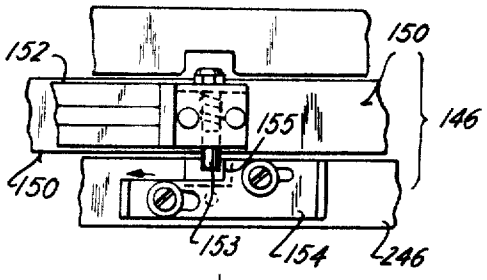


FIG. 7

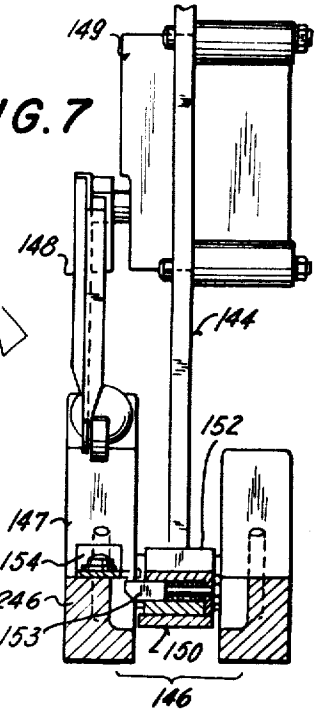
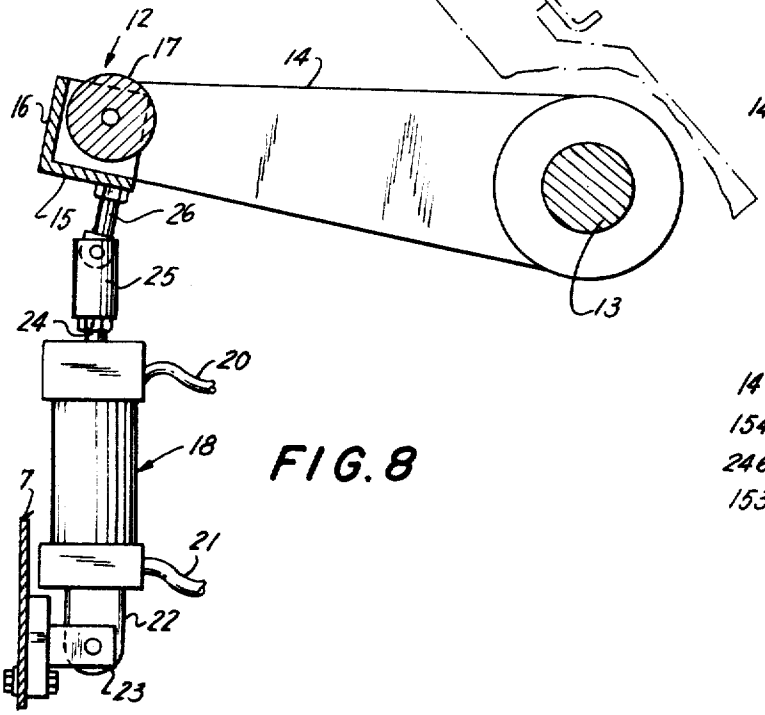


FIG. 8



AUTOMATIC CARTON CLOSING MACHINE

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FIG. 9

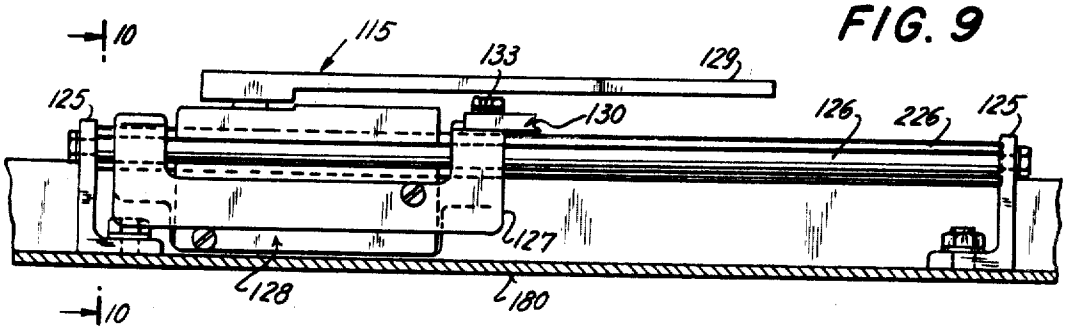


FIG. 10

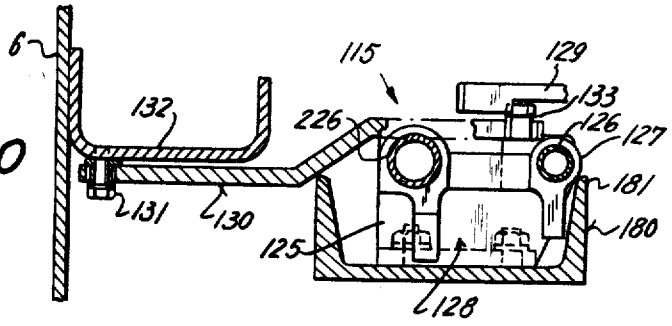
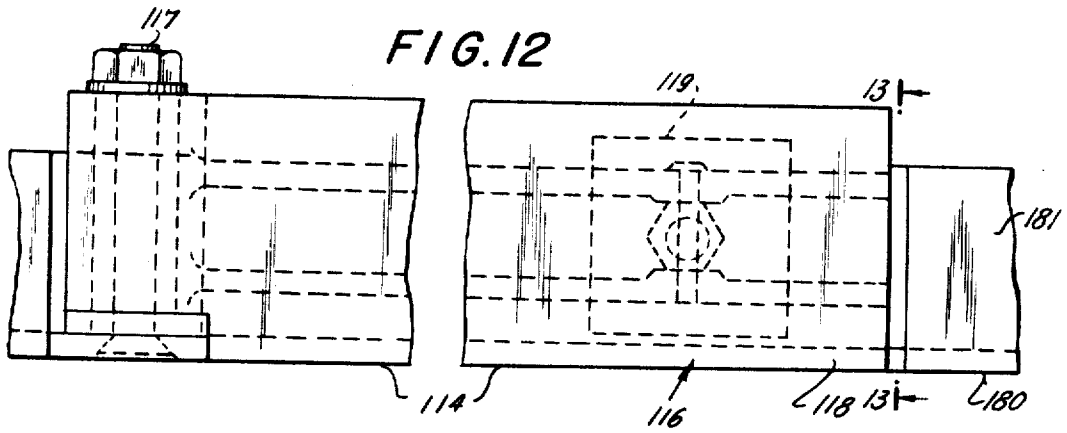


FIG. 12



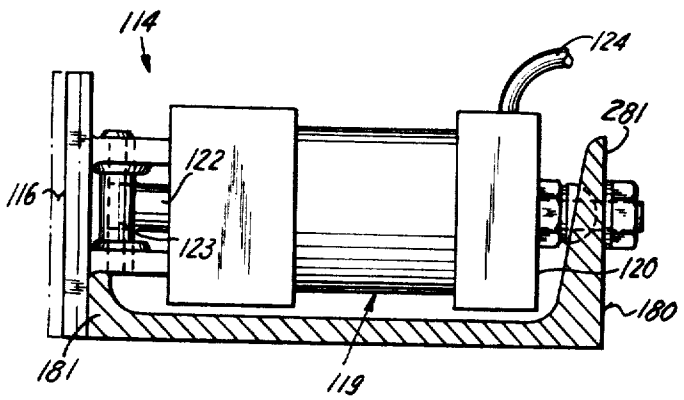


FIG. 13

FIG. 14

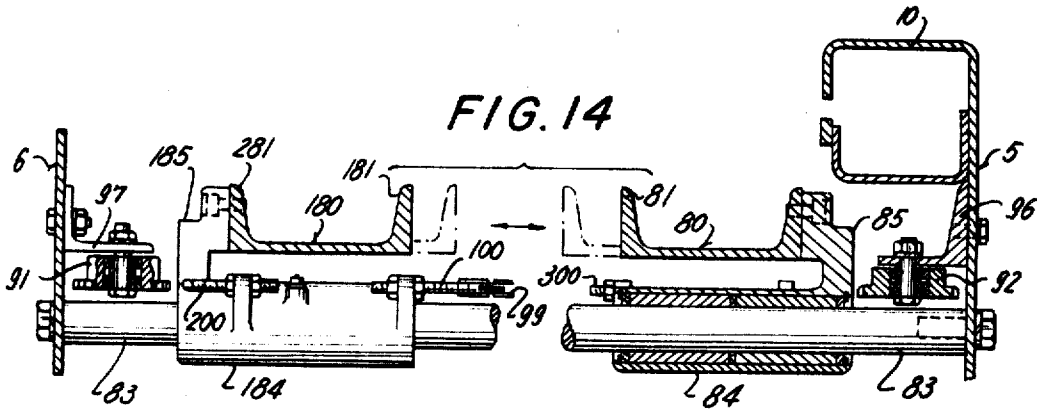
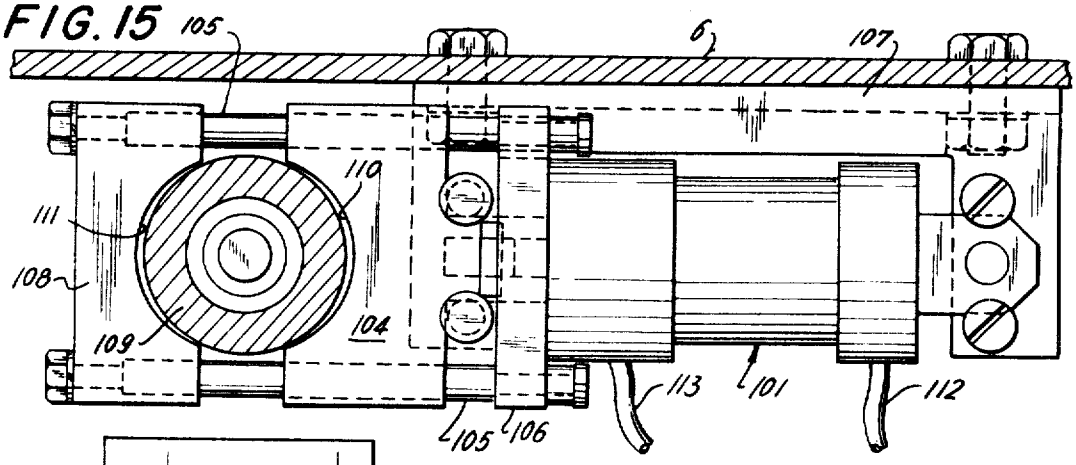


FIG. 15



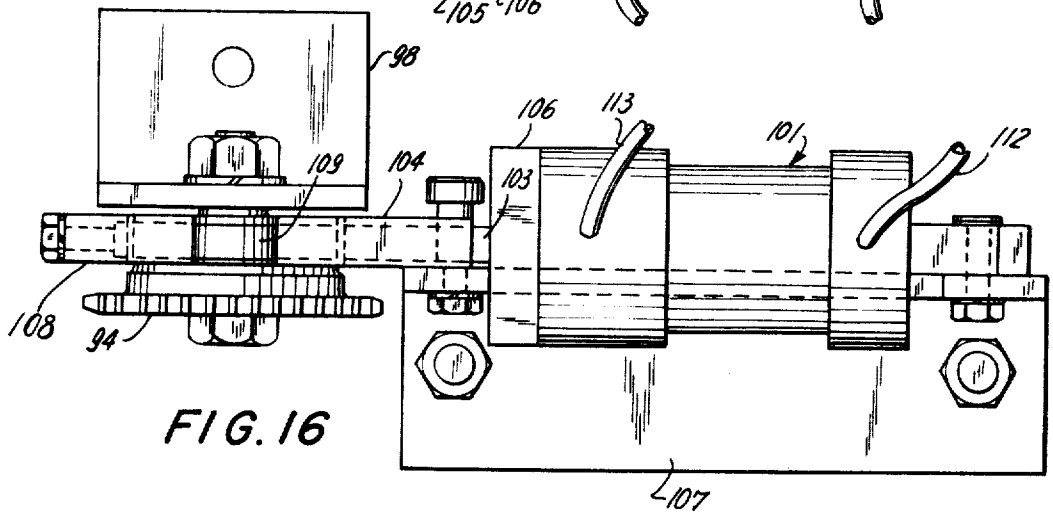
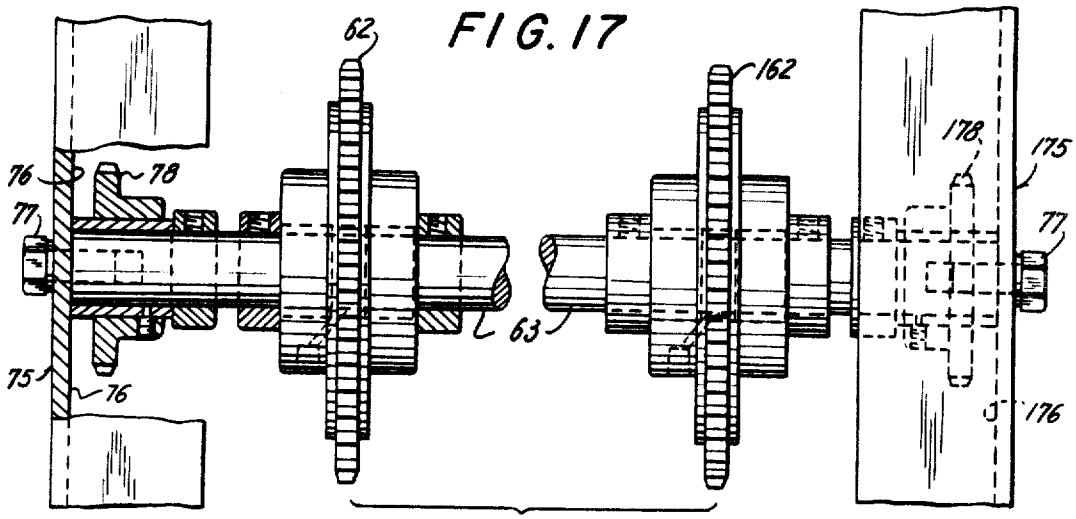


FIG. 16

FIG. 17


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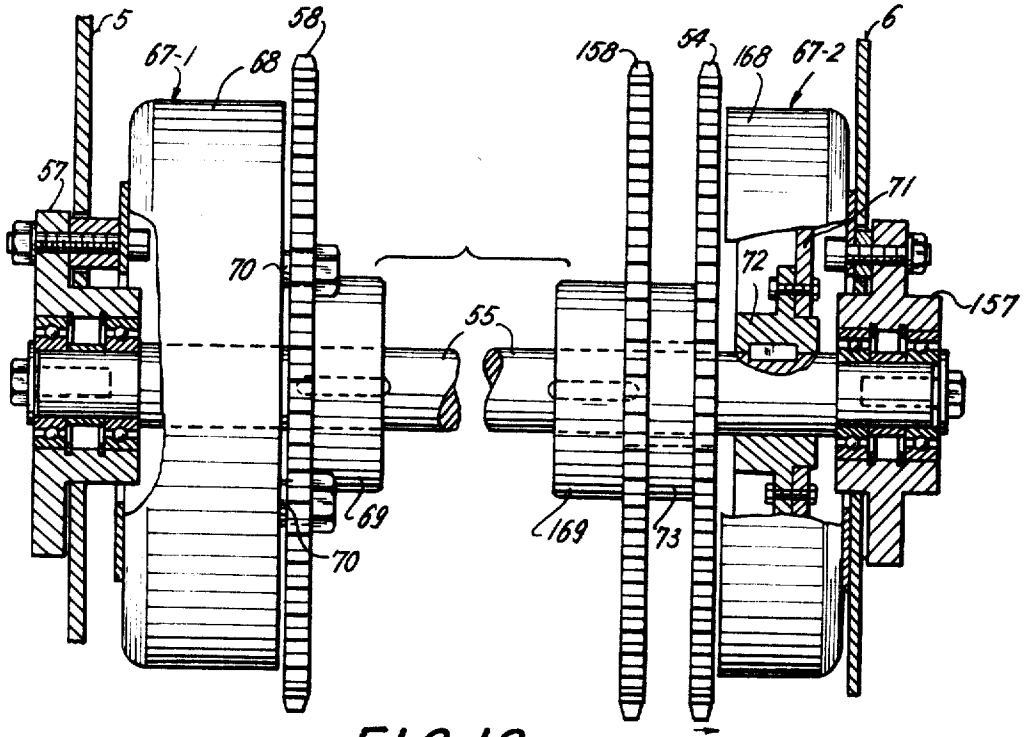

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FIG. 18

FIG. 19

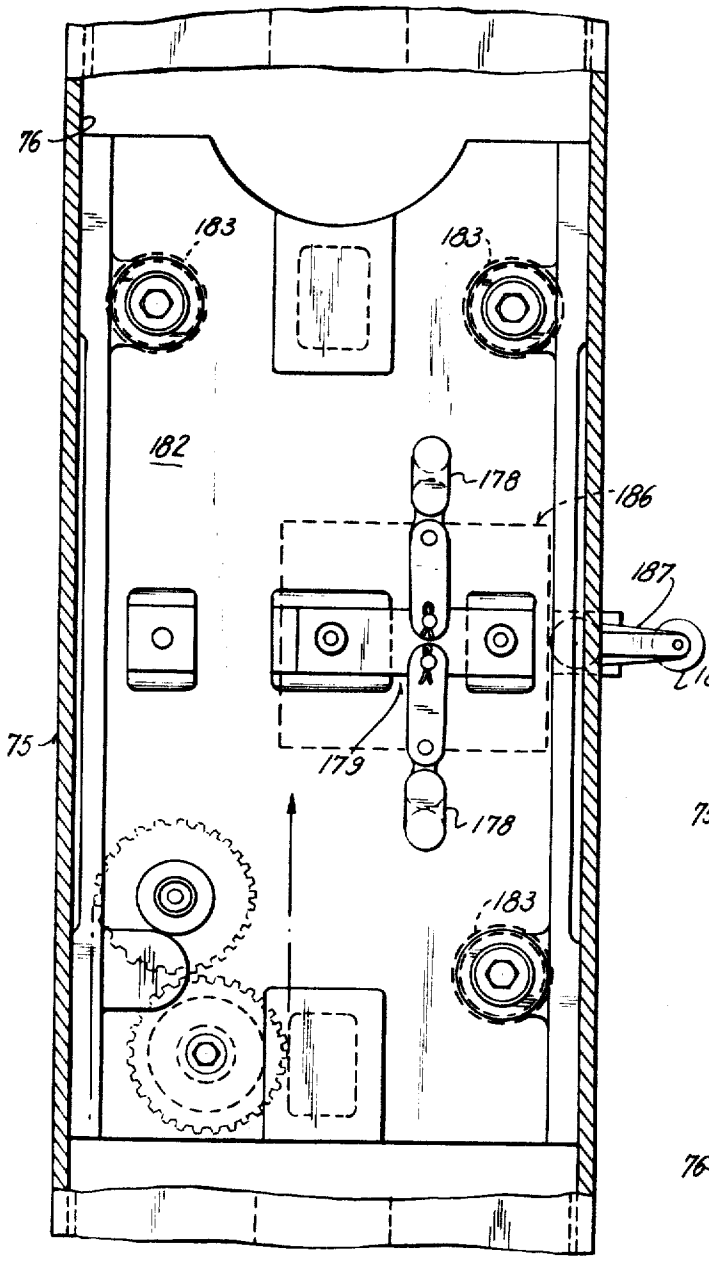
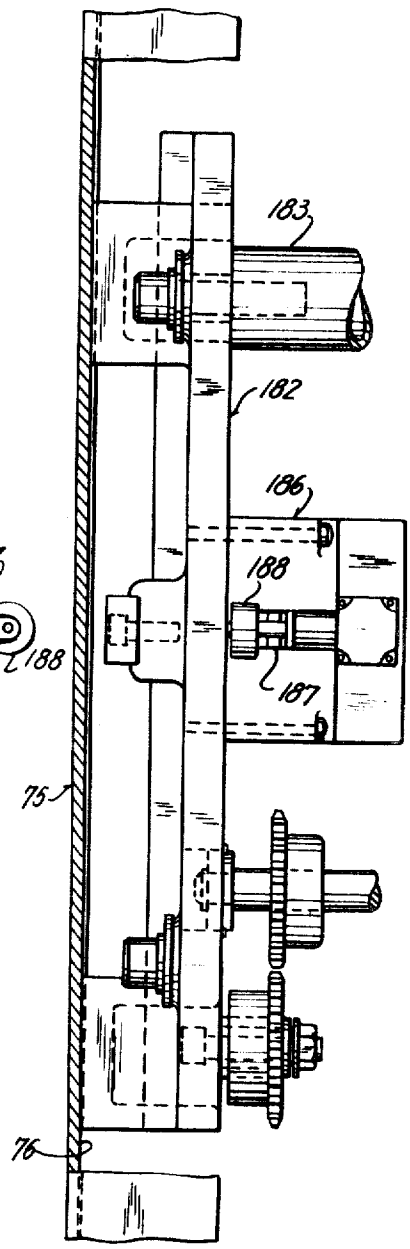

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FIG. 20


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AUTOMATIC CARTON CLOSING MACHINE

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FIG. 21

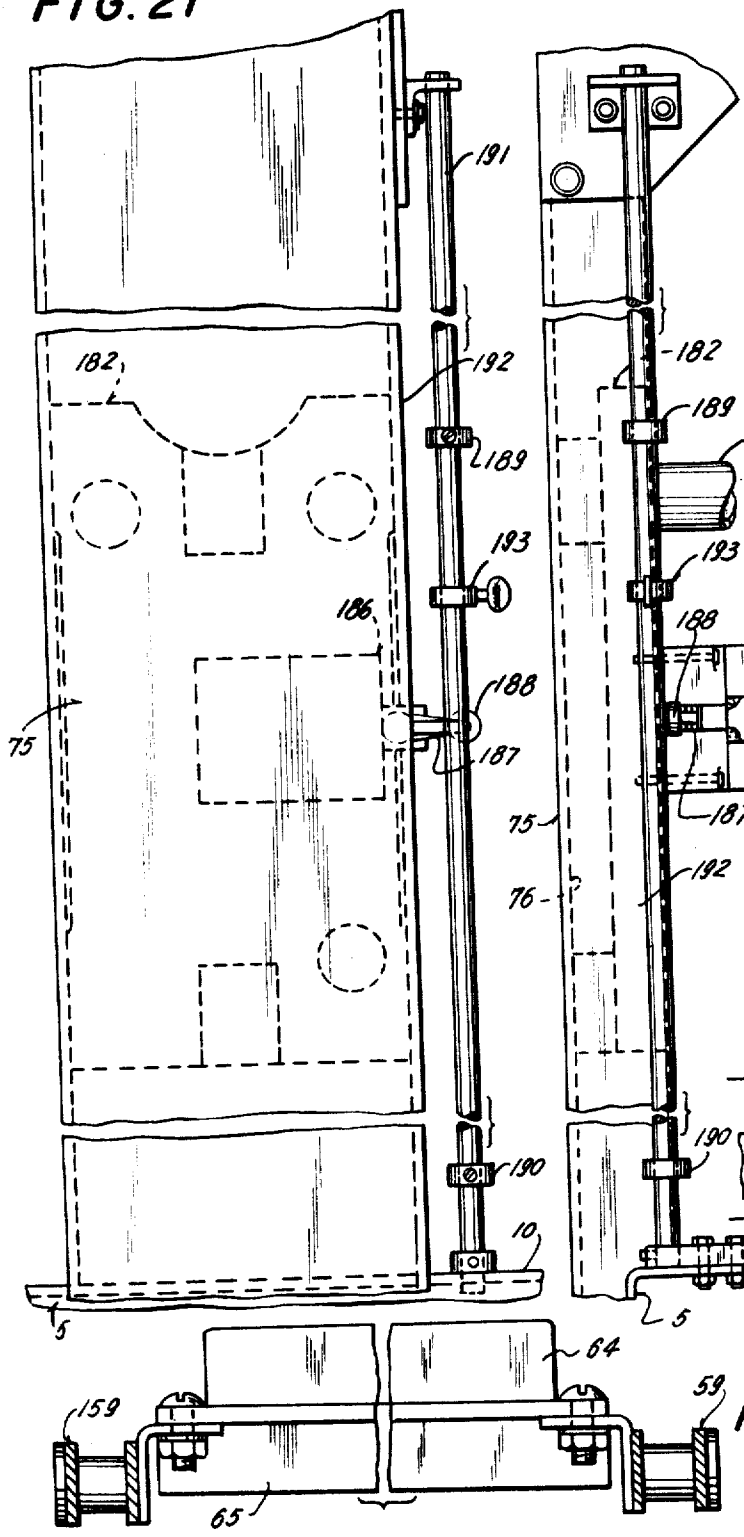


FIG. 22

FIG. 23

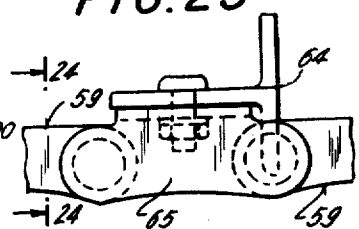


FIG. 24

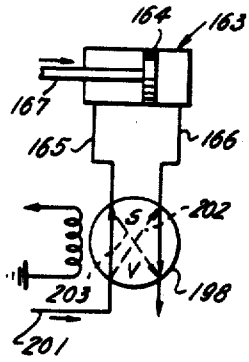
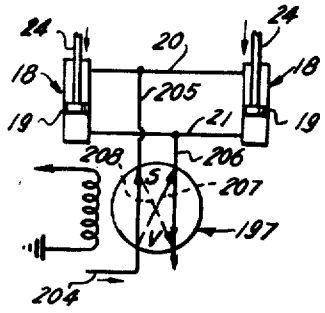


FIG. 25

FIG. 26



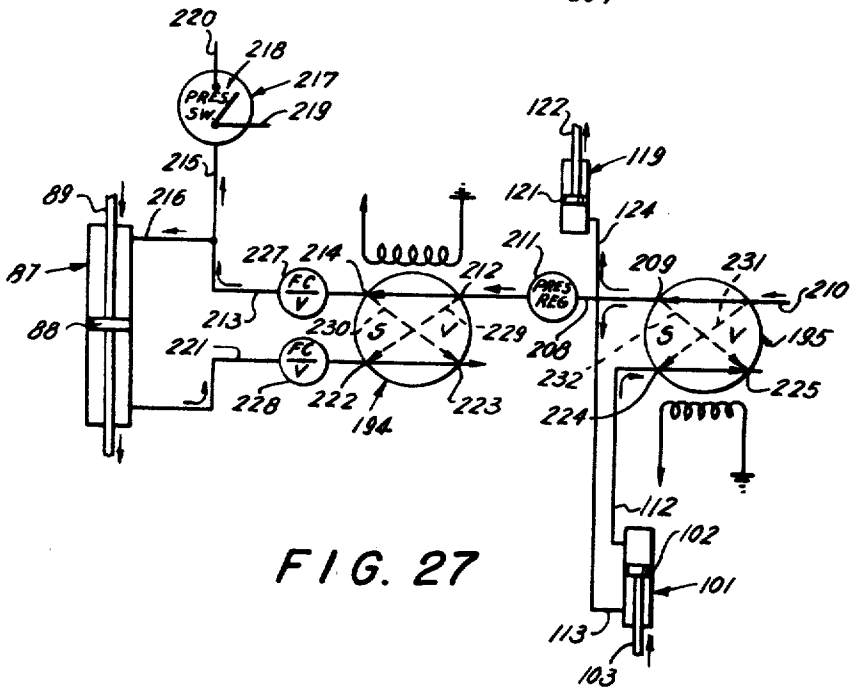
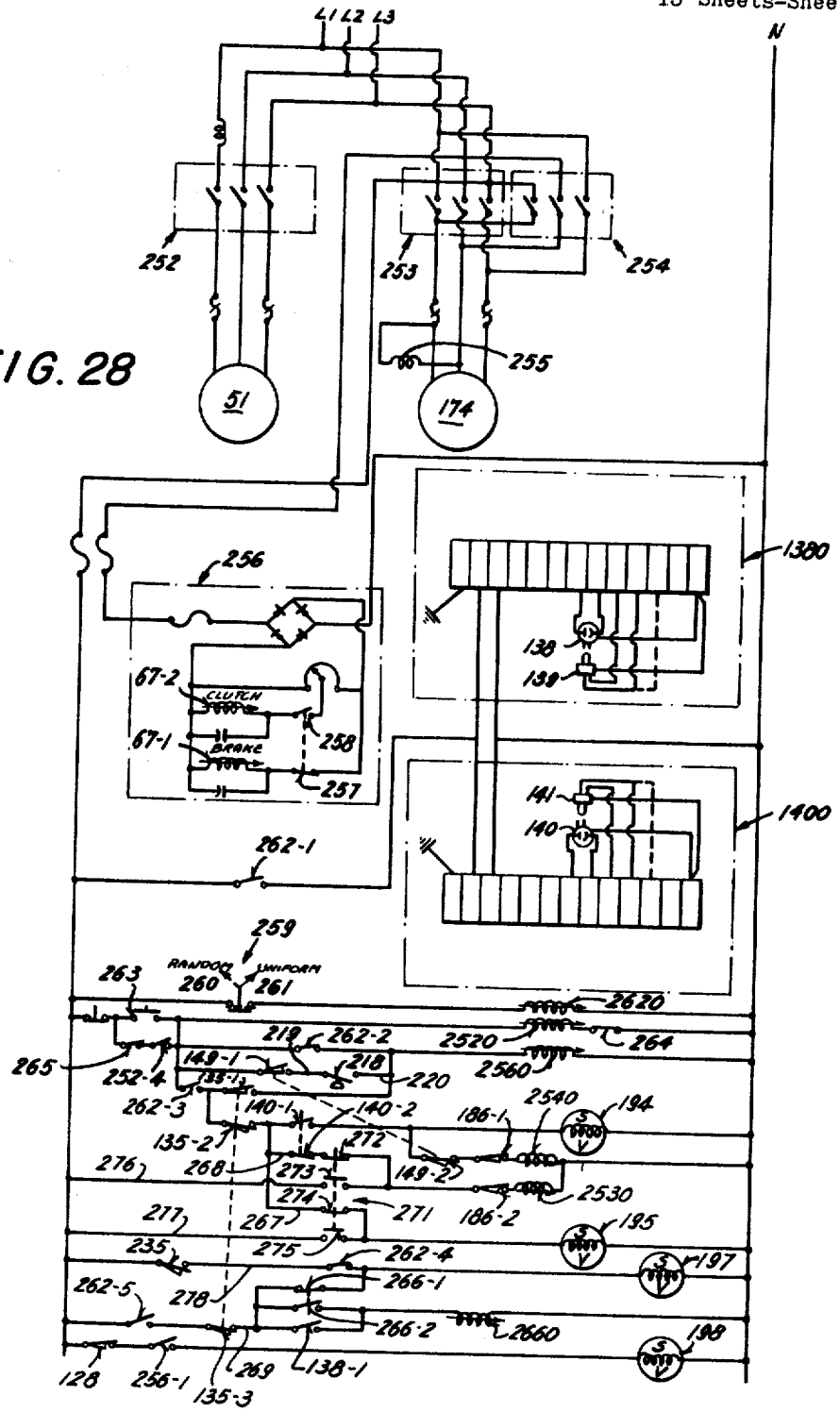


FIG. 27

FIG. 28

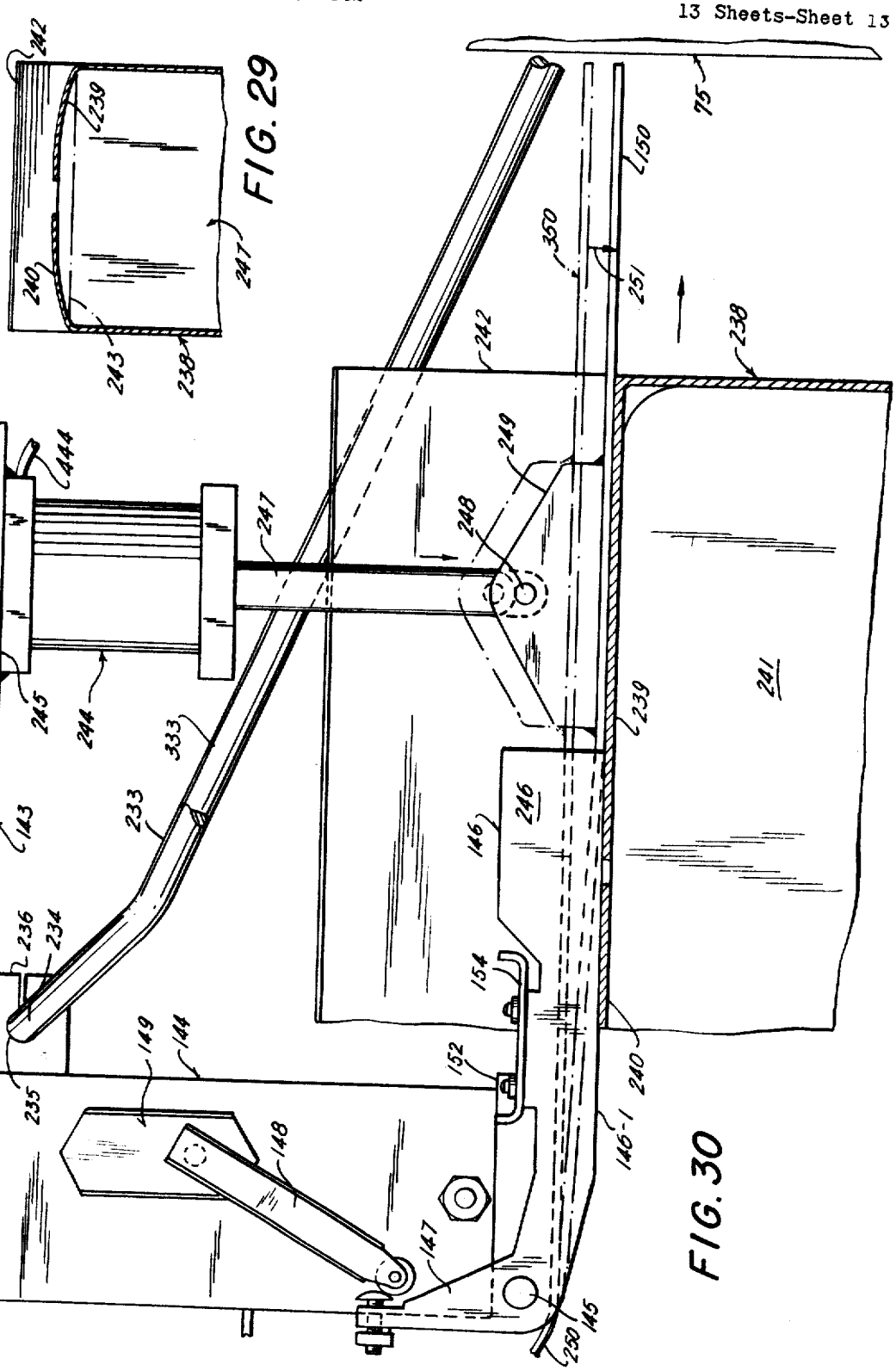

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BRAKE
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257
262-1
259
RANDOM
UNIFORM
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261
263
2620
264
2520
2560
265
252-4
149-1
135-1
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262-2
220
262-3
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135-2
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186-1
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149-2
2530
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186-2
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262-4
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266-1
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266-2
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256-1
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Re. 26,440
Reissued Aug. 13, 1968

26,440

AUTOMATIC CARTON CLOSING MACHINE

Winton Loveland, Freeport, and Saul Warshaw, New York, N.Y., assignors to The Loveshaw Corporation, Farmingdale, N.Y., a corporation of New York

Original No. 3,236,022, dated Feb. 22, 1966, Ser. No. 219,212, Aug. 24, 1962. Application for reissue Nov. 6, 1967, Ser. No. 682,702

25 Claims. (Cl. 53—75)

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

ABSTRACT OF THE DISCLOSURE

The present invention pertains to automatic carton closing machines. This machine folds down and inward the upwardly-extending front and rear flaps of a series of successive open-top cartons of random size to closed lateral positions so as to be lapped by downwardly and inwardly folded side flaps for securing the folded flaps together in carton closing positions. Such automatic machine embodies a lateral conveyor mechanism having an entrance end and a discharge end and defining therebetween a path of forward advance of carton travel along which the conveyor mechanism moves the cartons successively in spaced apart relation. Along this path is located a flap folding and sensing station where each carton is caused to pause for folding down and inwardly the upwardly extending front end flap. This flap folding operation is performed by an elevating head structure which is in an upper position as each carton is advanced to the station and which then descends to the top of the pausing carton to effect the front flap folding operation. This elevating head also carries rear flap folding mechanism to fold the upstanding rear flap downward and forward, and then it causes the side flaps to be folded over these folded end flaps for effecting the carton top closure which may be given by equipment of the machine a permanency, such as by applying adhesive tape thereover or other ways of securing the flaps together.

The present invention relates to machines for folding to closed positions the extending flaps of the open tops of conventional cartons, e.g., after they have been filled with goods to be distributed or marketed therein, and may supplement or embody any suitable folded flap securing means, such as the adhesive tape applying mechanism of our copending application for United States Letters Patent Serial No. 139,676, filed September 21, 1961.

Prior to the present invention various types of machines have been proposed semi-automatically or automatically to close the tops of successively fed loaded rectangular paperboard cartons, such as those formed from corrugated board, each having four upstanding flaps respectively located at the front, back and side top edges. It is common practice to close each carton top by folding these flaps down to a substantially common lateral plane in overlapping relation and securing them together, such as by applying adhesive to opposed flaps surfaces, or securing them together by staples or adhesive tape.

It is an object of the present invention to provide an unusually effective machine, which may be readily constructed and efficiently operated automatically to close successively the tops of a series of such cartons in a rapid and sure manner, and to adjust itself to the physical bulk and shape of each of a plurality of successive cartons as it is sensed thereby, although the cartons may be of random sizes.

Another object of the invention is to provide the machine with manual control means permitting it to be easily conditioned at will for continuous operation successively to close a plurality of cartons of uniform size sequentially fed thereto after it has automatically adjusted itself to one of the cartons of uniform size. Such operation on cartons of uniform size desirably is many times faster than the speed of closing successively a plurality of cartons of random sizes since, after adjustment to one of the cartons of uniform size, adjustment and sensing operations for accommodating carton dimensions are locked out effectively in accordance with the present invention. For cartons of uniform size it is no longer necessary to advance flap closing mechanism to the top of each carton and then retract it for successive advance to the next following carton, nor to do this with respect to carton clamping and guiding mechanism thereof. In other words, it becomes unnecessary for the machine to sense the size of each uniform carton at its flap folding station to dictate proper flap folding operations thereof.

A further object of the present invention is to provide carton responding control means dictating a certain flap folding operation with is automaticlly adjustable along the path of carton advance in the machine whereby the control means is positioned automatically farther forward in the vicinity of the flap folding means for narrower cartons than for wider cartons. The distance of this automatic advance is proportionate to the width of each carton. This is particularly advantageous since the width of a carton dictates the height of its upwardly-extending unfolded top flaps and the effectiveness of the folding of at least one of these flaps, such as the back flap on the trailing top edge of the carton, is improved for a plurality of successive cartons of different sizes being run through the machine if this particular flap of each carton is engaged by the folding mechanism in similar manner.

Other objects of this invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view to reduced scale, with parts omitted for clarity, of an embodiment of the automatic carton closing machine of the present invention;

FIG. 2 is a top plan view to larger scale, with parts broken away, of the entrance end of the bed unit of the machine shown in FIG. 1;

FIG. 3 is a view similar to FIG. 2, with parts in section, of the remaining discharge end of the bed of the machine;

FIG. 4 is an enlarged top plan view, with parts broken away, of a portion of the flap folding head of the machine depicted in FIGS. 1, 2 and 3;

FIG. 5 is a side elevational view to enlarged scale, with parts broken away, of flap folding mechanism shown in FIGS. 1 and 4, with members manipulated to alternative positions being indicated in dot-dash lines;

FIG. 6 is a detail view substantially on line 6—6 of FIG. 5, with parts broken away;

FIG. 7 is a back elevational view with parts in section taken substantially on line 7—7 of FIG. 5;

FIG. 8 is an enlarged section taken substantially on line 8—8 of FIG. 2, showing details of the entrance gate and its operating mechanism;

FIG. 9 is an enlarged sectional view taken substantially on line 9—9 of FIG. 2, showing parts in side elevation;

FIG. 10 is a sectional view, with parts broken away, taken substantially on line **10—10** of FIG. 9;

FIG. 11 is a top plan view, with parts broken away, of physical carton sensing control means, such as an electrical circuit switch, mounted for adjustable translation along the carton travel path shown in FIG. 2 to be located between the selector gate and head elevating mechanism at the sensing station, illustrating a portion of a carton thereat which effects operation of this switch;

FIG. 12 is an enlarged side elevational view, with parts broken away, taken substantially on line **12—12** of FIG. 2;

FIG. 13 is a sectional view taken substantially on line **13—13** of FIGS. 2 and 12, showing parts in elevation;

FIG. 14 is an enlarged sectional view, with parts broken away, taken substantially on line **14—14** of FIG. 2;

FIG. 15 is an enlarged detail plan view of clamping means for rail translating mechanism shown in FIG. 2, with parts in section;

FIG. 16 is a side elevational view of the clamping means shown in FIG. 15;

FIG. 17 is an enlarged detail, with parts broken away and in section, of sprocket equipment as viewed on line **17—17** of FIGS. 1 and 3;

FIG. 18 is a view similar to FIG. 17 of clutch and brake mechanism as viewed on line **18—18** of FIG. 3;

FIG. 19 is an enlarged side elevational view, with parts broken away and in section, of the near side flap folding head supporting column and the support slide mounted therein;

FIG. 20 is an elevational view with parts broken away and in section, of the back edge of the structure shown in FIG. 19;

FIG. 21 is a side elevational view, with parts broken away, of the near side column shown in FIGS. 19 and 20 and depicting certain limit switch mechanism thereof which dictates the maximum and minimum vertical travel of the flap holding head;

FIG. 22 is a back elevational view, with parts in section, of the structure shown in FIG. 21;

FIG. 23 is an enlarged detail of a flight bar of the second section chain conveyor of the machine, with parts broken away;

FIG. 24 is a sectional view taken substantially on line **24—24** of FIG. 23 with parts broken away and others shown in elevation;

FIG. 25 is a diagrammatic view of pneumatic equipment for operating the back flap folder or kicker mounted on the head and shown in FIG. 1;

FIG. 26 is a diagrammatic view similar to FIG. 25 of pneumatic equipment for operating the entrance or selector gate shown in FIGS. 1, 2 and 8;

FIG. 27 is a diagrammatic view similar to FIGS. 25 and 26 of the pneumatic equipment for operating the carton guiding and clamping rail structure depicted in FIG. 2, the clamping means for its translating mechanism depicted in FIGS. 15 and 16, and clearance arm means shown in FIGS. 2, 12 and 13;

FIG. 28 is a schematic wiring diagram of the electrical circuitry of the machine depicted in FIGS. 1 to 27 inclusive;

FIG. 29 is a vertical section, with parts broken away, of a top portion of a typical open-top loaded carton with the bulk of the contents being such as to overfill slightly the carton before compacting, and illustrating that resulting bulging of folded front and back flaps prevent sharp folding of side flaps along their scored break lines; and

FIG. 30 is an enlarged side elevational view, with parts broken away, of the flap folding head illustrated in FIG. 5 equipped with carton contents compacting means to assure depression of the folded front and back top flaps to the plane of the scored break line of the side flaps of the loaded carton of FIG. 29 (with a portion of the latter being shown herein) assuring solution of this over-filling problem.

Referring to the drawings, in which like numerals identify similar parts throughout, it will be seen, and particularly from FIGS. 1, 2 and 3, that the embodiment of the automatic carton closing machine illustrated by way of example therein may comprise a bed unit **1** and an elevating head unit **2** supported on the former by upwardly-extending standards or columnar structure **3**. Conventionally the parts of the machine are made of suitable metals. The bed unit **1** has a rectangular frame structure supported upon suitable legs **4**. The frame structure may include opposed side walls **5** and **6**, a relatively low end wall **7** at the entrance end, and another end wall **8** at the discharge end.

The bed unit **1** is equipped with lateral conveyor means suitably supported by the frame side walls **5** and **6**, and this conveyor means has an entrance end in the vicinity of end wall **7** and a discharge end in the vicinity of end wall **8**. This conveyor means defines a longitudinal path of forward carton travel along which it successively transports a plurality of open-top cartons. Such cartons are of conventional form being constructed, if desired, from corrugated board and rectangular in cross section with the edges of the top thereof provided with upwardly-extending front and back flaps respectively on the leading and trailing top edges and opposed upwardly-extending side flaps on the side top edges, all to be folded down to closed lateral lapping positions for securement in carton closing position. This machine of the present invention is designed automatically to close successively the tops of such cartons in this manner after they have been loaded with the products to be marketed or shipped therein. Accordingly, any suitable feeding means, such as a roller conveyor **9**, illustrated in FIG. 1, will be mounted adjacent the entrance end of the bend unit **1**, i.e., adjacent the end wall **7**, successively to feed a supply of the loaded cartons over the top edge of the latter to the conveyor means. The frame structure of the bed unit **1** may include lateral sheet metal ledges **10** and **11** extending inwardly from the top edges of the side walls **5** and **6** for support of certain control devices as will appear hereinafter, and strengthening cross framing members may be embodied.

At the entrance end of the bed unit **1**, in the vicinity of end wall **7**, is mounted a liftable gate **12** shown in FIGS. 1, 2 and 12. A cross shaft **13**, having its end supported by side walls **5** and **6** of the frame structure, pivotally supports a pair of swinging arms **14** which carry on their back ends a gate bar **15**. The gate bar **15** may be in the form of a length of angle stock having an upwardly-extending, carton-barring flange **16**. The gate bar **15** preferably supports thereon a rotatable roll **17** over which the bottom of a loaded carton may advance readily after a leading portion advances thereover. It will be understood that when the gate arms **14** are swung upwardly, or in a clockwise direction as viewed in FIGS. 1 and 8, the gate flange **16** will swing up above the plane defined by the tops of the series of feed rollers **9** to bar the leading end of a carton bottom suppled across the latter until this gate flange is lowered below this feed plane.

As will be seen from FIG. 8, the means for lifting and lowering the entrance gate **12** may be in the form of a double-action pneumatic cylinder **18** and, as is illustrated schematically in FIG. 26, a pair of such pneumatic cylinders may be provided with each connected to one end of the gate bar **15**. Each pneumatic cylinder **18** is provided with a piston **19** to opposite sides of which lead fluid conduits **20** and **21**, which alternately serve as supply and venting passages for opposite ends of the cylinder chamber. It will be understood from FIG. 8 that the bottom end of each pneumatic cylinder **18** has a supporting arm **22** pivotally connected to a bracket **23** fixedly mounted to end wall **7** of the frame structure.

The piston **19** of each pneumatic cylinder **18** is provided with a piston rod **24** coupled by a knuckle **25** to an arm **26** mounted to the gate bar **15**. Thus, when pressurized air is fed to the top conduits **20** of the pneumatic cylinders **18**, the pistons thereof will be retracted to lower the gate flange **16**, with vent of the opposite end of the cylinders through the conduits **21**. When pressurized air is supplied through the bottom conduits **21** of the pneumatic cylinders **18** with the top ends of the latter vented through the conduits **20**, the gate bar **15** will be raised to lift the gate flange **16** to carton-barring position across the path of supplied cartons.

The conveyor means includes a continuously driven, initial endless section **27** indicated in FIG. 1 and seen in FIG. 2. For this purpose, an idling roller **28** is rotatably supported by a pair of arms **29** pivotally mounted on the cross shaft **13**. A driving shaft **30** is rotatably supported by bearing units **31** between the frame side walls **5** and **6**, and carries fixed thereto a driving roller **32**. The initial conveyor section **27** preferably is in the form of an endless belt lapped about the rollers **28** and **32**. As will be best seen from FIG. 1, a bottom run of the conveyor belt **27** is lapped back and forth about idling rolls **33** and **34** with the latter supported by tension adjusting devices **35**. The shaft **30** carries a sprocket **36** fixed thereto to be driven by a drive chain indicated by dot-dot-dot-dash lines **37** in FIGS. 2 and 3. The endless driving chain **37** has a run lapped against a guiding idler **38** and is lapped about a driving sprocket **39**. Driving sprocket **39** is one of a group of three thereof fixed together with the second **40** constituting means for driving tape feeding mechanism and the third **41** constituting the driving sprocket about which is lapped a driving chain indicated by dot-dot-dash lines at **42** in FIG. 3. The group of sprockets **39**, **40** and **41** are rotatably supported by a cross shaft **43** and the tape feed sprocket drives tape feeding mechanism which constitutes no part of the present invention, comprising sprockets **44** and **45** about which an endless chain is lapped and a sprocket **46** against which the drive chain **42** is lapped in turn to drive a cross shaft **47** of tape feed mechanism. The endless chain **42** is lapped about a driving sprocket **48** fixed to a driving stub shaft **49** of a reduction gear unit **50** operated by a main driving electric motor **51**. The driving stub shaft **49** also carries fixed thereto another driving sprocket **52** about which is lapped an endless driving chain indicated by dot-dash lines at **53** in FIG. 3, in turn lapped about a driven sprocket **54** rotatably supported by a cross shaft **55** equipped with suitable brake and clutch devices for drive of a second conveyor section as is explained hereinafter.

Cross shaft **13** also carries, rotatably supported thereon, a pair of near and far idler sprockets **56** and **156**, as will be seen in FIG. 2, while cross shaft **55** is rotatably supported by bearing units **57** and **157** carried by frame side walls **5** and **6**, as will best be understood from FIG. 18. Drive shaft **55** carries fixed thereto a pair of near and far sprockets **58** and **158** respectively aligned with sprockets **56** and **156**. The second endless conveyor section preferably is in the form of a pair of endless chains, indicated by dot-dash lines **59** and **159** in FIGS. 2 and 3, respectively lapped about sprockets **56** and **58**, and **156** and **158**, for drive by sprockets **58** and **158**. As will be best understood from FIG. 1, the lower run of each of the endless chains **59** and **159** is lapped beneath one of a pair of idlers **60** and **160** rotatably supported by a cross shaft **61** mounted between frame side walls **5** and **6**, and beneath another of a pair of idlers **62** and **162** rotatably supported by another cross shaft **63** shown in FIG. 17. The second endless conveyor section also includes a series of carton transporting flight bars **64** which, as is indicated in FIG. 1, may be four in number spaced longitudinally appreciably apart. As is indicated in FIGS. 23 and 24, each flight bar **64** may be in the form of an upstanding flange supported by a saddle **65** to which are connected links of the conveyor chains **59** and **159**. The pair of conveyor chains **59** and **159** also carry a plurality of reversed flight bars **164** which may be similar to the flight bars **64** and incorporated in the endless chains in a manner similar to that illustrated in FIGS. 23 and 24. There may be a pair of the reversed flight bars **164**, and each constitutes a carton stop having the function of holding a carton at a sensing station when the second conveyor section pauses or is held in stop position, as will be understood from the operation described hereinafter. The endless conveyor chain **59** on the near side, as viewed in FIG. 1, also is equipped with a plurality of tripping lugs **66–1** and **66–2** to be carried along therewith for operating certain limit conveyor means described hereinafter, and there may be a pair thereof each associated with one of the carton stop flight bars **164**.

It will thus be seen that the initial conveyor section comprising endless belt **27** has an entrance end near the vicinity of the selector gate **12** and a discharge end at a point appreciably in advance thereof which, as will be explained later, is at a carton sensing and flap folding station. From the discharge end of the initial conveyor section or belt **27** suitable fixed carton-supporting structure extends forward, and this may be in form of a pair of fixed rails **270** suitably supported between the frame side walls **5** and **6** and terminating in the vicinity of the discharge end wall **8**, as will be seen from FIGS. 2 and 3. It will also be understood therefrom that the second conveyor section comprising conveyor chains **59** and **159** and their flights **64** extend forward at least from the discharge end of the belt conveyor **27** to the discharge end of the bed unit **1**. As will be apparent from FIG. 2, preferably the entrance end of the chain conveyor appreciably laps the discharge end of the belt conveyor and, in fact, has its chain-supporting front sprockets **56** and **156** rotatably supported on the same cross shaft **13** which pivotally carries the arms **29** rotatably supporting roller **28** about which the entrance end of the conveyor belt **27** is lapped. Thus, any carton which is delivered to the sensing and flap folding station by the conveyor belt **27** will be picked up there by an oncoming flight **64** of the chain conveyor to be slid forward over the rails **270** to the discharge end of the bed unit **1**.

The near end of driven cross shaft **55** carries a housed magnetic brake **67–1** and the far end thereof carries a housed magnetic clutch **67–2**, both of which may be of conventional construction. For example, the frame side wall **5** may fixedly support through fixed housing **68** of the brake unit **67–1** fixed field coils and core structure thereof opposed to an axially slidable armature therein. Hub **69** of drive sprocket **58** is keyed to the drive shaft **55** and the sprocket in turn carries circumferentially-spaced, axially-extending pins **70** on which is slidably mounted for axial motion the armature, which may be in the form of a paramagnetic disc (hidden in housing **68**). The fixed core structure is annular and has a friction face equipped with suitable brake lining material opposed to a face of the slidable armature plate, so that when the brake field coil is energized the armature plate is drawn axially against the brake lining of the fixed magnetic core structure to clamp it thereto and prevent the driven cross shaft **55** from rotating. The clutch unit **67–2** is of somewhat similar structure with the field coil thereof also fixedly supported by housing **168** therewithin which is in turn fixedly mounted to the frame side wall **6**. The annular core structure, a portion of which is seen at **71** in FIG. 18, is carried by a hub **72** keyed to the driven shaft **55**. While the hub **169** of sprocket **158** is also keyed to the driven shaft **55**, the drive sprocket **54** has its hub **73** freely supported on this shaft for relative rotation and axial motion toward the keyed core structures **71**, and sprocket **54** may be constructed of paramagnetic material to serve as the annular armature. Thus, when the field coil of the clutch unit **67–2** is energized, the

drive sprocket **54** will be slid axially outward a short distance to have its outer face engage a friction facing of suitable material carried by the annular magnetic core structure **71** keyed to the shaft, to connect the shaft and the conveyor chain driving sprockets **58** and **158** keyed thereto to the shaft drive sprocket **54**. Since the magnetic brake and clutch units **67–1** and **67–2** are of conventional construction, further structural details thereof are not necessary to an understanding of their functions and operations, and they are alternately operated or energized for alternate periodic drive and pause of the chain conveyor section.

As will be understood from FIGS. 1, 3 and 17, the support structure **3** includes an opposed pair of upwardly-extending standards or columns **75** and **175** which constitute supports for the elevating head unit **2**, and these columns are fixedly mounted to the frame side walls **5** and **6** of the bed unit **1** in any suitable manner. The columns **75** and **175** preferably are of channel construction so as to provide guiding channels **76** and **176** for head-supporting slides or carriage means therein, and to house elevating mechanism. Opposite ends of the cross shaft **63** extend into the channels **76** and **176** and are fixedly mounted to these columns by any suitable means, such as stud bolts **77**. Within the channels **76** and **176**, fixed cross shaft **63** rotatably supports sprockets **78** and **178**, forming a part of head elevating mechanism, as is explained here following.

As will be understood from FIGS. 2, 3 and 9 to 14 incl., the bed unit **1** is equipped with suitable carton clamping and carton travel guiding means, preferably extending from the vicinity of the entrance end to a distance short of the discharge end of the bed **1**, but entirely through the carton sensing and flap folding station in the vicinity of the discharge end of the initial conveyor section or belt **27**. This carton clamping and guiding structure may be in the form of a pair of rails **80** and **180**, which may be of channel formation, as shown, to provide on the inner sides thereof opposed upstanding flanges **81** and **181**. As will be understood from FIGS. 2, 3 and 14, the clamping and guiding rails **80** and **180** are suitably supported by a pair of transverse rods **82** and **83** mounted to the frame side walls **5** and **6**. Each of the rods **82** and **83** supports a pair of slides **84** and **184** carrying bracket arms **85** and **185** to each of which is mounted one of the rails **80** and **180**, as will be best seen in FIG. 14. Thus, the guiding and clamping rails **80** and **180** are slidably supported on transverse rods **82** and **83** for transverse movement inward and outward relative to the center of the path of carton travel defined by the longitudinally-extending conveyor means. In their outward positions, depicted in FIGS. 2 and 3, the rails **80** and **180** are at their initial carton-receptive positions to permit a carton feed over depressed gate **12** to the entrance end of the initial conveyor section belt **27** to advance therebetween. The front end of each of the rails **80** and **180** preferably is equipped with a freely rotating carton guide roller **86** to facilitate entrance of a carton therebetween.

The clamping and guiding rails **80** and **180** are slid transversely back and forth on the guide rods **82** and **83** by suitable driving mechanism. Such rail driving mechanism may be in the form of a fluid pressure motor, such as a pneumatic cylinder **87** of the double-action type having its piston head **88** equipped with a through piston rod **89**, as will be best understood from FIG. 27. The rail driving mechanism includes lateral sprockets **90**, **91**, **92**, **93**, **94** and **95**. Sprockets **90** and **92** are supported on frame side wall **5** by a bracket **96** while sprockets **93** and **95** are supported by a similar, reversely-shaped bracket **196**. Sprocket **91** is supported on side wall **6** by a bracket **97** and a bracket **98** is employed to support sprocket **94** on the latter side wall, as will be understood from FIGS. 2 and 14 to 16 inclusive. Lengths of link chain are lapped about the sprockets **90** to **95** incl. and anchored to opposite ends of the piston rod **89**, with suitable connections to the slides **84** and **184** to drive the rails **80** and **180** transversely inward and outward. For example, a length **99** of such link chain is anchored to the right end of piston rod **89** as viewed in FIG. 2 and lapped about sprocket **90** to extend transversely to an anchor bolt **100** carried by slide **184** on slide rod **83**. Slide **184** also carries another chain anchor bolt **200** to which one end of another chain length **199** is anchored, with the latter lapped about sprocket **91** to extend transversely back to another anchor bolt **300** carried by slide **84** on slide rod **83**. The latter slide **84** also carries an additional anchor bolt **400** to which a third length **299** of the chain is connected, with the latter lapped about sprocket **92** to extend longitudinally back for lap about sprocket **93** and then transversely to a fifth anchor bolt **500** carried in like manner by slide **184** on slide rod **82**. This slide **184** also carries another anchor bolt **600** to which a fourth length of chain **399** is anchored and then lapped about sprocket **94** to extend transversely back to an additional anchor bolt **700** carried by slide **84** on slide rod **82**, with a further anchor bolt **800** on the latter slide having connected thereto a fifth length of chain **499** lapped about sprocket **95** to extend longitudinally forward to connection with the left hand end of the piston rod **89**. Thus, when the piston rod **89** of the pneumatic cylinder **87** is slid longitudinally to the right, as viewed in FIG. 2, the clamping and guiding rails **80** and **180** are driven transversely outward to their initial carton-receptive positions shown therein, and when the piston rod is then reciprocated in the opposite direction to the left in FIG. 2 these rails are driven transversely inward toward each other for approach of their inside flanges **81** and **181** to opposite sides of a carton delivered therebetween.

Referring to FIGS. 15 and 16, it will be seen that a clamping device is provided in association with the sprocket **94**, to hold the guiding and clamping rails **80** and **180** in an adjusted position, such as the initial retracted position illustrated in FIGS. 2 and 3. Such clamping means may include another pneumatic cylinder **101** of the double-action type, as is also indicated in FIG. 27, having its piston head **102** carried by a piston rod **103** which exteriorly of the cylinder is connected to or abutted against an arcuate clamping shoe **104**. The arcuate clamping shoe **104** is slidably mounted on a pair of rods **105** supported by head structure **106** of the pneumatic cylinder, with the latter in turn supported by a bracket **107** mounted to frame side wall **6**. The guide rods **105** carry on the far ends thereof a fixedly mounted arcuate clamping shoe **108** in opposed relation to the shoe **104**. Cylindrical hub **109** of the sprocket **94** is located between opposed arcuate faces **110** and **111** of the clamping shoes **104** and **108**, so that when the latter are forced toward each other by feed of pressurized fluid or air to the cylinder **101** by way of conduit **112** behind the piston head **102**, this sprocket is clamped in stop position to hold the rails **80** and **180** in their relative adjusted positions. The space in the cylinder **101** ahead of the piston **102** is vented through conduit **113** when pressurized air is fed to the space therebehind by conduit **112**, and when the functions of these conduits are reversed the pressurized air is fed to the space in front of the piston head to retract the clamping shoe **104** and free sprocket **94**, so as to permit pneumatic cylinder **87** to adjust the relative positions of the rails **80** and **180** by transverse drive.

The front end of guiding and clamping rail **180** carries opposite the belt conveyor section **27**, in the area of the carton sensing and flap folding station clearance means **114** and an adjustable control or sensing device **115**, as will be seen in FIG. 2. The clearance means **114** is in the form of a pivoted arm **116**, details of which are shown in FIGS. 12 and 13. A section of the inward side flange **181** of rail **180** is cut out and clearance arm **116** is pivotally supported at **117** therein, with

its free end **118** extending in the direction of carton forward travel. In order to actuate the clearance arm **116** from a retracted full line position, shown in FIGS. 2 and 13 by swinging it inward away from the rail a fraction of an inch to the dot-dash position, a third pneumatic cylinder, of the single action type, **119** is provided on the rail. As is indicated in FIG. 13, the outer side flange **281** of rail **180** swivelly supports the back end **120** of the pneumatic cylinder **119**, and the piston head **121** (shown in FIG. 27) carries a piston rod **122** connected by a knuckle **123** to the back side of the free end **118** of the clearance arm **116**. Thus, when pressurized air is fed to the back end of cylinder **119** by conduit **124** the piston head **121** and its piston rod **122** are thrust forward to swing free end **118** of the clearance arm **116** inward to the dot-dash position. The clearance arm **116** may be retracted toward its full line position upon discontinuance of feed of the pressurized air to the back end of cylinder **119**, as a result of resistive force applied thereto by contact with a carton side wall when the carton is clamped between the rails **80** and **180** at this point. If desired, such retraction of the clearance arm **116** may be more positively or fully attained by mounting a helical compression spring about the piston rod **122** within the head space of the cylinder **119** in front of the piston head **121**. The advantage attained by the provision of the clearance arm **116** is more fully explained here following in connection with a description of a typical operation of the machine.

For the purpose of supporting the adjustable control **115** upon the guiding and clamping rail **180**, the latter carries a pair of opposed brackets **125** (see FIGS. 2, 9, 10, and 11). The brackets **125** support therebetween a pair of longitudinally-extending guide rods **126** and **226** upon which a carriage **127** is slidably mounted. Carriage **127** supports a control device **128**, which may be in the form of an electrical circuit switch biased to one of its open and closed positions and manipulated to the other thereof by an actuating arm **129**. As will be best understood from FIGS. 2 and 11, the switch actuating arm **129** is elongated and extends longitudinally forward while having its mid-section shaped to be disposed substantially parallel to the inward face of flange **181** of rail **180** when retracted or swung back by contact with carton side structure. Thus, when the rails **80** and **180** are driven inward toward each other with a carton disposed therebetween opposite the control **115**, the back side of the carton which is opposed to the switch operating arm **129** will first be contacted thereby. Then, as the rails **80** and **180** are brought to clamping positions against the opposite sides of the carton, this switch operating arm **129** will be retracted or pushed back to the position of FIG. 11 to operate the switch **128**. The control device comprising switch **128** and its actuating arm **129** are automatically adjustable along the path of carton forward travel as dictated by the width of the carton. For example, a narrow carton causes the clamping rails **80** and **180** to be driven inward toward each other an appreciable distance and the control device **128** will be advanced forward an appreciable distance. With wider cartons, where inward travel of the clamping rails **80** and **180** is relatively small, the control device **128** will be advanced forward only a short distance. This automatic adjustment of the position of the control device **128** is attained by substantially rigid tie means pivotally connected to the fixed structure of the bed frame and to the control carriage **127**. For example, elongated rigid arm or strap **130** is pivotally mounted at **131** to a channel **132** fixedly supported by bed frame wall **6**, with its other end pivotally connected at **133** to the carriage **127**, as will be understood from FIGS, 2, 10 and 11. Thus, as rail **180** is driven transversely inward toward the center of the longitudinal path of carton forward travel, the tie **130** is swung counterclockwise to pull the control carriage **127** forward along the guide rods **126** and **226**. This forward adjustment of the position of the control device **115** is proportionate to the width of the carton at the carton sensing and flap folding station, and this forward adjustment action, as well as the retraction of the actuating arm **129**, is illustrated in FIG. 11, wherein a side wall portion of a carton is indicated at **134** to which is abutted inner side flange **181** of rail **180** with the actuating arm **129** retracted for alignment of its mid-portion therewith.

The bed unit **1** also is provided with additional control equipment. As will be seen from FIG. 1, the frame of the bed unit **1** supports a limit control **135**, which may be in the form of electrical circuit switching means having a plurality of switches mechanically linked together for simultaneous operation. The limit switch **135** is provided with an actuating trigger **136** designed to be swung up and down and biased to its downward position with a drag roller **137** carried by its lower end. Limit switch **135** preferably is supported upon ledge **10** beyond the head-supporting up-right column **75**, such as in the vicinity of the location "X" indicated in FIG. 3, so that the roller **137** on the actuating trigger **136** will be dragged over the next oncoming traveling lug **66–1** or **66–2** carried by conveyor chain **59**. When the upper run of conveyor chain **59** in its forward travel causes lug **66–1** to engage the trigger **136**, the latter will be swung up to actuate the switches in the limit switch unit **135**, and the circuit switches thereof will be held to their respective manipulated positions until this run of the conveyor chain advances sufficiently to free the trigger and thus permit the limit switches to be returned to their initial positions. The limit switch unit **135** is provided for "Random" operation of the machine, i.e., to close random size cartons. For operation of the machine to close uniform size cartons, it may be set to a "Uniform" setting, as explained hereinafter, and, for this purpose, the machine will be equipped with another limit switch unit of a construction similar to that at **135** except for the number of circuit switches controlled thereby. This second limit switch unit preferably is supported on the opposite ledge **11** substantially opposite to the location of limit switch unit **135** on ledge **10**, with its actuating trigger depending for drag against a plurality of lugs carried by conveyor chain **159**, and with each associated with one of the flights **64**, as hereinafter explained.

The clearance lever **116** and the switch actuated arm **129** constitute physical sensing devices for contact with the side of a carton at the sensing station. Additional sensing devices are provided on the bed unit **1**, which may be in the form of optical carton sensing devices. For example, as will be seen from FIGS. 1 and 2, the ledge **10** may support at **138**, in the vicinity of the selector gate **12** and slightly in advance thereof a photo cell responsive to the light beam from a light source **139** supported on the opposite side by ledge **11**. At the sensing and flap folding station, preferably opposite the clearance means device **114** ledge **10** may support in similar fashion, substantially at the point **140**, a second photo cell arranged opposite to a second light source for response to the beam thereof, with the latter being located substantially at the point **141**. The functions of the photo cells at **138** and **140** will be explained in connection with the wiring diagram of FIG. 28 and the operation of the machine detailed hereinafter.

In FIG. 1 is shown in dot-dash lines an open-top carton "Y" located opposite the photo cell optical sensing device **140** at the sensing and flap folding station, beneath a flap folding and carton closing head **142** supported for elevating travel upon the upright columns **75** and **175**. Head **142** includes a lateral frame member or beam **143** from which depends a post **144**, as will be understood from FIGS. 1, 4, 5 and 7. The bottom end of depending post **144** pivotally carries at **145** a front flap folding arm structure **146**, which, due to gravity biasing, normally

depends in the top elevated position of the head **142** shown in FIG. **1** obliquely down and forward to the full line position shown in FIG. 1, and the dot-dash position shown in FIG. 5. The front flap folding arm structure **146** carries a finger **147** which engages a trigger **148** of another limit control, which may be an electrical circuit switch device **149** supported on the post **144**. In the full line position of the front flap folding arm structure **146** shown in FIG. 1 its finger **147** holds the switch trigger **148** forward to a tripped position to hold the switch in one of its open and closed positions. When the front flap folding arm structure **146** is swung upward to a lateral position, indicated in FIG. **1** in dot-dash lines and in full lines in FIG. 5, the trigger **148** of switch **149** is released to permit the switch to be actuated to the other of its two positions. The bottom of the depending post **144** has anchored thereto, such as by welding, one end of a folded flap hold-down device in the form of a resilient presser strip **150**, which extends forward with its free end unsupported, to cooperate with the front flap folding arm structure **146**. As will be seen from FIGS. 1 and 5, the flap hold-down strip **150** may have a continuating portion at its anchored back end, which is turned up obliquely and then inward to additional anchorage to the depending post **144**, so as to provide a wedge-shaped stop **250** for a back flap folding arm or kicker hereinafter described.

The elevating flap folding head **142** also may have a forwardly extending lateral frame member "A" which supports suitable flap securing mechanism, which may be tape applying means of the type disclosed in our above-identified copending patent application Ser. No. 139,676, including pairs of wipe down arms "B" and "C," to which are supplied from a suitable tape supply reel "D" lengths of gummed tape to be adhesively affixed over overlapping flaps of a carton top after the flaps have been folded down in stacked or overlapping relation. Since operation of the present machine is not limited to the employment of type applying mechanism as means to secure the overlapped flaps together, no further details of this part of the flap folding head **142** need be here recited. This is likewise true with respect to similar tape applying devices carried by the bed unit **1**, including another adhesive tape supply reel "E" (see FIGS. 1 and 2), tape feed and drive sprockets **40**, **44** and **45**, tape mechanism cross shaft **47** and its drive sprocket **46**, tape feed actuators "F" (supported on rail **180**, see FIG. 3) and associated structure not herein described, since such tape supplying and applying means form no part of the present invention.

It will be seen from FIGS. 5, 6 and 7 that the front folding flap arm structure **146** preferably is bifurcated or in the form of a fork between the furcations or tines of which is located a lateral projection **152** supported on the bottom end of depending post **144** and carrying on its front end a spring-biased detent **153**. One furcation **246** of the fork **146** carries a slidable latch plate **154** which is cut back, as shown in FIG. 6, to provide a nose **155**, which will be engaged above the spring biased latch in the lateral full line position of the front flap folding arm seen in full lines in FIG. 5, upon the latch plate being manually slid or retracted toward the pivot point **145**. By this means the front flap folding arm **146** is latched to its lateral or horizontal position for "Uniform" carton size operation.

The lateral frame member or beam **143** of head **142** pivotally supports at **151** a carton back flap folding arm or kicker **161**, as will be seen from FIGS. 1 and 4. The back flap folding arm or kicker **161** is normally held in an extended or substantially lateral position when the flap folding head **142** is elevated to the maximum height of its vertical travel, as is shown in FIG. 1. For this purpose the lateral beam **143** carries a kicker actuating means, preferably in the form of a pneumatic cylinder **163**, as is shown in FIGS. 1 and 4 and diagrammatically illustrated in FIG. 25. This pneumatic cylinder **163** is of the double-action type with pressurized fluid being alternately fed to opposite ends on opposite sides of its piston head **164** by suitable conduit means, such as **165** and **166**. Piston rod **167** connected to piston head **164** of the pneumatic cylinder **163** is connected by a knuckle **170** to a lever arm **171** fixed to the hub of the pivoted kicker **161**, as will be seen from FIG. 4. Thus when pressurized air is supplied to the back end of pneumatic cylinder **163** through conduit **166**, the rear flap kicker **161** is swung backward and upwardly to its substantially lateral cocked position, shown in FIG. 1, with the head space of the cylinder in front of piston head **164** being vented by conduit **165**. It will be seen from FIG. 1 that the bottom side of the rear flap kicker **161** is provided with a depending tapered nose **172** having an oblique rear face **173–1** which, when the kicker is swung down to its depending position indicated in dot-dash lines in FIG. 1, is oriented to substantial parallelism with the oblique stop **250**. The cocked kicker **161** is swung down to this position to engage or strike the rear face of an upstanding back flap on the trailing end of the open top of a carton and kick it forward to folded lateral position by reversing the pneumatic connection to cylinder **163**, i.e., by supplying pressurized fluid or air to conduit **165** and venting through conduit **166**, to retract the piston rod **167**. When the kicker **161** is swung down the oblique rear face **173–2** of its tapered nose **172** provides a flat lateral bottom surface substantially in the horizontal plane of the bottom surface **146–1** of front flap folding arm structure **146** when swung up, as are indicated in dot-dash lines in FIG. 1. These aligned bottom surfaces of the flap folding arms **146** and **161** maintain the folded front and back flaps in a common lateral plane during forward transport of the carton which effects the folding down of the side flaps.

The top of the column **75** and **175**, which support the head **2** for vertical reciprocation, fixedly support at their top ends a reversing electric motor **174**, as is indicated in FIG. 1. The drive of reversing motor **174** is suitably geared to a pair of top drive sprockets **177** and **277** carried by the top ends of the columns **75** and **175**. Drive chain **178** is lapped about drive sprocket **177** in the vicinity of the top end of column channel **75** and about the bottom idler sprocket **78**, shown in FIGS. 3 and 17, with opposed ends thereof anchored by suitable means at **179** to a slide **182** riding up and down in channel **76**, as will be understood from FIG. 19. In similar fashion, a like chain (not shown) is lapped about the far top sprocket **277** and bottom idler sprocket **178**, and is anchored in like fashion to a similar slide of reversed form located in channel **176** of column **175**. The opposed pair of slides (including that shown at **182** in FIGS. 19 and 20) are suitably tied together to act as a carriage unit, such as by a plurality of tie rods or tubes **183**, one of which is shown in FIG. 20, and the locations of which are indicated in FIG. 19. The carriage comprising the pair of slides **182** and its companion suitably support the lateral frame member or beam **143** for vertical travel down and up therewith. Thus, when the reversing vertical travel motor **174** is driven in one direction the entire head structure **2** is lowered to position its flap folding means above an open top carton at the sensing and flap folding station, such carton being indicated at "Y" in FIG. 1, and when driven in the opposite direction will lift this head structure to its initial elevated position, such as that indicated in full lines in FIG. 1.

Maximum limits of up and down motion of the head structure **2** are dictated by suitable limit means, which may be in the form of switch means in electrical circuitry of the reversing motor **174**. Such switch means may be of the double-throw type so as alternately to open the energizing circuits of the reversing motor **174** to limit the down and up drive thereof. Such reversing motor control switch unit is shown in FIGS. 19 to 22 incl. at **186** suitably mounted on slide **182**. Switch unit **186** is provided with a double-action actuating trigger **187** carrying a roller

188 arranged to be abutted in its up and down travel to top and bottom stop collars 189 and 190, fixed upon a vertical control rod 191 supported by bed unit frame ledge 10 and the back edge flange 192 of column channel 75, as will be seen from FIGS. 21 and 22. The vertical control rod 191 also preferably carries an additional stop collar 193, which may be adjusted in its elevational position by its set screw in the form of a wing screw, as shown therein. Thus adjustable collar 193 may serve to dictate the top limit of lift of the head structure 2. The bottom stop collar 190 will limit lowering of the head structure 2, so as to assure that no parts thereof will be driven down to jam against any of the bed unit structure should the down energizing circuit of the reversing motor 174 accidentally be closed in the absence of a carton at the sensing and flap folding station, thus being provided as a safety measure.

The gearings shown in FIGS. 19 and 20 as being carried by the carriage slide 782 forms part of the tape supply mechanism for cooperation with the tape applying means "B" and "C" carried by the arm "A" of the head structure 2, and thus need not be herein described.

It will be understood by the diagrammatic showings in FIGS. 25, 26 and 27 that pressurized fluid, such as air, is supplied to the various actuating pneumatic cylinders 18, 87, 101, 119, and 163 through suitable flow control solenoid valves, preferably of the four-way type, so that paths of flow may be reversed alternately. As is indicated in FIG. 27 the pneumatic system in which the rail operating cylinder 87, the reel driving mechanism stop clamp cylinder 101, and the clearance arm operating cylinder 119 are located, are controlled by such four-way solenoid valves 194 and 195. The selector gate operating cylinders 18 are controlled by such a four-way solenoid valve 197, as is indicated in FIG. 26; and the back flap folding kicker operating cylinder 163 is controlled by such a four-way solenoid valve 198.

As will be seen from FIG. 25, pressurized air fed through a supply conduit, indicated at 201, may upon energization of four-way solenoid valve 198, be passed straight through to conduit 165 and to the head end of cylinder 163 to retract the piston rod 167, so as to swing the back flap folding kicker 161 down from cocked position, with the opposite end the cylinder 163 being vented to exhaust through conduit 166 and flow back straight through the solenoid valve 198. When four-way solenoid valve 198 is de-energized, the passages therethrough are cross-connected so that supply conduit 201 is thus communicated along the path 202 through the valve to the conduit 166, with cross communication of conduit 165 along the path 203 to the venting port, so as to cause the piston rod 167 to be thrust outwardly for swinging the depending back flap folding kicker 161 from its down position, indicated by dot-dash lines in FIG. 1, up to the cocked full line position thereof.

As will be seen from FIG. 26, when pressurized air is fed through supply conduit 204 with the four-way solenoid valve 197 energized it passes straight through to a conduit 205 connected to the common conduit 20 so as to supply the air to the top ends of the gate retracting cylinders 18, with venting of their bottom ends through the common conduit 21, conduit 206 connected to the latter and back straight through the solenoid valve to exhaust. When the solenoid valve 197 is de-energized it cross-connects the supply conduit 204 and the exhaust port with the conduits 206 and 205 respectively by way of paths 207 and 208 through the valve.

The pneumatic system diagrammatically shown in FIG. 27 includes four-way solenoid valves 194 and 195, which are shown therein in their energized conditions. A conduit 208 is connected between a port 209 of solenoid valve 195 and also to conduit 113 of clamp actuating cylinder 101 and conduit 124 of clearance arm operating cylinder 119. Thus, when pressurized air is fed through supply conduit 210 it passes straight through solenoid valve 195 and its ports 209 to conduit 208 for supply to the bottom ends of cylinders 119 and 101 and onward through a pressure regulator 211 to a supply port 212 of energized four-way solenoid valve 194. The supplied pressurized air thus passes straight through the latter to a conduit 213 connected to port 214 for feed to conduits 215 and 216. Conduit 215 is connected to a pressure switch unit 217, with switch 218 thereof being biased to open condition to break an electrical circuit which may be connected to terminals 219 and 220 thereof. Feed of pressurized air through conduit 215 to pressure switch unit 217 will thus cause the switch 218 to close at a critical pressure, and when the pressure drops below this critical value the switch will again open the circuit. Supply of pressurized air through conduit 216 to the top end of rail driving cylinder 87 will cause its piston rod 89 to travel downwardly to cause intervening mechanism to move the guiding and clamping rails 80 and 180 inwardly toward each other. The bottom end of the cylinder 87 is connected by conduit 221 to a port 222 of solenoid valve 194 so that air will be vented through this conduit and port back straight through this valve to exhaust port 223 thereof. The conduit 112 of the cylinder 101 is connected to a port 224 of solenoid valve 195 which leads straight through an exhaust port 225. A pair of flow control valves 227 and 228 are respectively connected in the conduits 213 and 221.

Thus, when both solenoid valves 195 and 194 are energized, pressurized air is fed successively therethrough to the pressure switch 217 to close it and to the top end of pneumatic cylinder 87 to move the rails 80 and 180 transversely inward toward each other. At the same time pressurized air is fed to the bottom end of the cylinder 119 to extend its piston rod 122 and swing the clearance arm 116 out away from the inside face of flange 181 of rail 180, toward the opposed inside face of the flange 81 of rail 80. Also, at this time pressurized air is fed through conduit 113 to the bottom end of the pneumatic cylinder 101, so as to retract its piston rod 103 for freeing the clamping mechanism 104–108 and releasing the rail driving mechanism to permit the rails 80 and 180 to be driven transversely inward toward each other. If now solenoid valve 194 be de-energized while solenoid valve 195 remains energized, the pressurized air will be fed from conduit 208 through the cross path 229 in solenoid valve 194 to the conduit 221 for supply to the bottom end of pneumatic cylinder 87, so as to move its piston rod 89 upwardly for retracting or transversely moving apart the rails 80 and 180, with the top end of this cylinder being vented back through conduits 216 and 213 and cross path 230 to the exhaust port 223. Thus, with maintenance of the energization of the solenoid valve 195 alternate energization and de-energization of solenoid valve 194 will successively move the clamping rails 80 and 180 toward and away from each other.

Upon de-energization of solenoid valve 195 pressurized air is fed through its cross path 231 to port 224 for supply through conduit 112 to the back end of pneumatic cylinder 101, so as to thrust its piston rod 103 outwardly for again applying clamping force to the rail driving mechanism to hold the rails in adjusted relative positions, and the opposite end of this cylinder is vented back through conduit 113, a portion of conduit 208 to port 209 and along cross path 232 to exhaust port 225. The back end of pneumatic cylinder 119 is simultaneously vented back through conduit 124 and this venting path also to exhaust port 225.

Thus, when the rail driving mechanism is clamped by the clamping devices 104–108 pressurized air is not supplied to either end of the pneumatic cylinder 87, so that there is no tendency to drive the rail moving mechanism in either direction while the clamp is applied, and vice versa. The clearance arm 116 is extended by pneumatic cylinder 119 only when pneumatic cylinder 87 causes the rails 80 and 180 to move transversely inward toward or

outward away from each other. The pressure switch **218** is closed only when pressurized air is being supplied to the pneumatic cylinder **87** to drive the clamping rails **80** and **180** inward toward each other. Accordingly, if this pneumatic cylinder **87** is capable of so moving these rails at a pressure lower than that necessary to close the pressure switch **218** it is possible to delay closure of the latter when the rails have been brought inward to clamping positions adjacent opposite sides of a carton with continued supply of pressurized air through conduit **216** and following a time interval during which the pressure may be gradually built up in the pressure switch unit **217** to the critical switch closing pressure.

As will be seen from FIGS. 1, 4 and 30, the flap folding head structure **142** includes suitable carton side flap folding plows **233** and **333** which extend from initial top ends at **234** and **334** obliquely down in an advance direction while converging toward each other. Preferably the plows **233** and **333** are provided as sections of a length of rod stock having a transverse mid-section **433** supported by suitable anchoring means or a clamping device **236** mounted in the angle between the bottom side of the beam **143** and the depending post **144**. As is presently known in the art, plows of such shape will gradually turn over and fold down upwardly-extending carton flaps when they are moved forward to engagement of their outside faces against the inner sides of such plows.

The operation of the present machine in automatically closing successively a series of loaded open top cartons is explained hereinafter. In the event that one such carton may be overly filled, so that as its front and back top flaps are folded down they are bulged up above the break lines of the side flaps, the folding of the latter may bend the side flaps above their scored break lines to produce an ineffective or unsightly closure of the carton top. The presser plate **150** of the flap folding head **142** is intended to dictate folding of the front and back top flaps to a common plane in which is substantially disposed the scored break lines of the side flaps, but the downward biasing thereby due to the stiffness of this presser plate may not be sufficient to attain this desired end with certain such overfilled cartons. This problem is readily solved by applying supplemental biasing to the presser plate **150**, as is proposed in FIG. 30. Let it be assumed that such an overfilled carton **238** has the appearance of that depicted in FIG. 29 with its folded front and back flaps **239** and **240** bulged by the excessive quantity **241** of the product loaded thereinto. The plane of the scored break lines of the side flaps **242** is indicated by the dot-dash line **243** and it is seen from FIG. 29 that the end portions of the front and back folded flaps **239** and **240** are disposed in a plane appreciably above this break line plane. Thus, the folding down of the side flaps **242** may cause them to be bent along the plane of disposition of the opposed end portions of the bulging folded front and back flaps **239** and **240**. This undesirable result can be avoided if sufficient pressure is applied to the top surfaces of the upwardly bulging folded front and back flaps **239** and **240** to compact the product load **241** within the carton chamber and depress these folded flaps down to the plane of the scored break lines **243** of the side flaps **242**. As is proposed in FIG. 30 supplemental biasing force may be applied to the presser plate **150** in the form of a pneumatic cylinder **244** having its back end **245** suitably abutted and anchored to the underside of beam **143**. Pneumatic cylinder **244** may be of the single action type with a supply conduit **444** feeding air to the chamber thereof behind its piston, so as to thrust downwardly piston rod **247**. The piston rod **247** has its lower end pivotally connected at **248** to a bearing shoe **249** superposed on the presser plate **150**, and suitably anchored thereto, such as by welding, if desired. Thus, when pressurized air is fed to the cylinder **244** through its supply conduit **444**, such as by manipulation of a valve, manually or otherwise, in this flow line, the presser plate **150** will bias the folded front and back flaps **239** and **240** down to the full line positions shown in FIG. 30 with compression of the carton contents **241**, to assure that these folded flaps are substantially disposed in a plane of the scored break lines **243** of the side flaps **242**. Thereafter, folding down inward and toward each other the side flaps **242**, for stacking them upon the folded front and back flaps **239** and **240**, by the plows **233** and **333** will assure that these side flaps are swung inward about their scored break lines **243** to attain a proper and sightly closure of the top of the carton. It will be seen from FIG. 30 that the application of force by air pressure applied through cylinder **244** moved the presser plate **150** down from its dot-dash position indicated at **350** to its full line position shown in FIG. 30, through the distance **251** indicated therein, effecting this compacting operation.

CONDITIONING OF CIRCUITRY FOR "RANDOM" OPERATION

Reference should be had to the wiring diagram of FIG. 28 for an understanding of the following operations. The power is turned on to energize "L1," "L2" and "L3," with the A.C. starter switches **252** in the supply circuit of the main motor **51** and the A.C. reversing starter switches **253** and **254** of the vertical motion motor **174** open. Starter switches **252** are closed by energization of relay coil **2520**. The "Up" starter switches **253**, which dictate drive of motor **174** in one direction for lift of the head **2**, are closed by energization of relay coil **2530**, and the "Down" starter switches at **254**, which dictate reverse drive of this motor for lowering the head, are closed by energization of relay coil **2540**. A brake coil **255** is associated with motor **174** to hold it in stopped position. A recifier circuit **256** for converting A.C. power to D.C. energy supplies the latter to magnetic brake **67–1** and magnetic clutch **67–2** through parallel circuits which are alternately closed. The circuit of the magnetic brake **67–1** includes a biased-closed switch **257** and the circuit of the magnetic clutch **67–2** includes a biased-open switch **258**, and these switches are tied together for simultaneous alternate opening and closing by relay coil **2560**. Since relay coil **2560** is initially de-energized, the brake circuit switch **257** remains closed with the brake applied to the drive of the chain conveyor **59–159**.

A carton size switch **259** is then set to its "Random" position **260** to close it, and the open position thereof is a "Uniform" setting **261**. This closure of the size switch **259** closes the circuit of a relay coil **2620**. Energized relay coil **2620** closes a switch **262–1** to energize photo cell system **1380**, which includes the photo cell **138** in the vicinity of the selector gate **12**, and photo cell system **1400**, which includes the photo cell **140** at the sensing and flap folding station (occupied by the carton at "Y" in FIG. 1). When the beam of light from the light source **139** in the vicinity of the selector gate **12** is interrupted by an entering carton (as it moves forward from the supply position "Z" in FIG. 1), the excitation of photo cell **138** is discontinued to effect closure of a circuit switch **138–1** (located in a circuit near the bottom of FIG. 28). When the beam of light from the light source **141** is interrupted by a carton at the sensing and flap folding station (position "Y" of FIG. 1), the excitation of photo cell **140** is discontinued to close a normally open switch **140–1** and open a normally closed switch **140–2**.

Energization of relay coil **2620**, upon closure of the size switch **259**, manipulates a plurality of switches associated therewith, including the normally open switch **262–1**, a normally closed switch **262–2**, a normally open switch **262–3**, a normally closed switch **262–4** and another normally open switch **252–5**. Normally closed switch **262–2** is located in the energizing circuit of relay coil **2560** leading from a "Start" button switch **263** which also controls the energizing circuit of relay coil **2520** that includes an overload switch **264**. The "Start" button switch **263** is shunted by a holding circuit which includes a magnetic

overload switch **265** and normally open switch **252–4** controlled by relay coil **2520**, so that when the latter is energized this holding circuit will continue to supply energy to the branch circuits leading from the "Start" push button switch **263**. Normally open switch **262–3**, which is closed by energization of relay coil **2620**, is located in a circuit shunting switch **262–2** in the energizing circuit of relay coil **2560**, and the latter cannot now be energized, because switch **262–2** is held open by the energization of relay coil **2620**, except through one of two shunt circuits, i.e., either through switches **149–1** and **218** connected in series, or through switches **262–3** and **135–1** connected in series.

Switch **149–1** is one of a pair incorporated in the sensing switch unit **149** supported by the flap folding head **142** and is biased toward closure while being held open by the depending orientation of the front flap folding arm structure **146**. The other switch **149–2** of this switch unit **149** is biased toward open position and is held closed by this depending orientation of the front flap folding arm structure **146**. Switch **218** is the pressure switch of FIG. 27, which ultimately is closed by build up of the pressure of pressurized air in the pressure switch unit **217** to a critical value. Thus, when the flap folding head **142** is lowered down over an open top carton at the sensing and flap folding station "Y" in FIG. 1, with attendant upward swing of front flap folding arm structure **146** to the lateral position indicated in FIGS. 5 and 30, the trigger **148** of switch unit **149** is released to allow its switches **149–1** to close and **149–2** simultaneously to open, which is at the instant that the height of the carton at this station is sensed physically.

Switch **135–1** in the other shunt circuit for relay coil **2560** is one of a set of three switches of the limit switch unit **135** controlled by the tripping lugs **66–1** and **66–2** on the conveyor chain **59**, and its is biased toward closed position and held open when one of these lugs trips the trigger **136** upward and holds it in this position until the lug passes therebeneath. The other two switches **135–2** and **135–3** of the limit switch unit **135** are biased toward open positions and are held closed while the trigger **136** of this limit switch is in engagement with one of the chain lugs **66–1** and **66–2**. Thus, in the absence of cartons in the machine and while the brake **67–1** is applied to the drive of the chain conveyor **59–159** with one of the lugs **66–1** and **66–2** holding the limit switch unit **135** tripped, the switch **135–1** is held open and switches **135–2** and **135–3** are held closed until the clutch **67–2** effects drive of this conveyor section to release the trigger of this limit switch unit.

Since the energization of relay coil **2620** closed switch **262–5** at the same time that it opened switch **262–4**, the solenoid valve **197** is energized through switch **135–3** (being held closed by the tripping of the limit switch unit **135**) and a normally closed switch **266–1**. As was explained in connection with FIG. 26, energization of the solenoid valve **197** caused pressurized fluid or air to be supplied to the top ends of the pneumatic cylinders **18** to retract or lower the selector gate **12**, thereby permitting entrance of the leading edge of the bottom of a carton in the position "Z" of FIG. 1 for advance over the lowered gate. Switch **266–1** is one of a pair controlled by a relay coil **2660** which may be energized through photo cell system switch **138–1** when closed, to close switch **266–2** when switch **266–1** is simultaneously opened thereby. Thus, switch **266–2** is located in a holding circuit shunted around the photo cell system switch **138–1** to maintain energization of the relay coil **2660** after this photo cell system switch is opened by advance of an entering carton beyond the photo cell **138** in the vicinity of the selector gate **12**, so as to maintain switch **266–1** open with solenoid valve **197** de-energized. Consequently, the selector gate **12** is lifted to beneath the bottom of the advancing carton and will be maintained in its lifted position to bar the entrance of the next oncoming carton while this carton is being permitted to slide forward over the gate roller **17** onto the initial conveyor section belt **27** for advance to the sensing and flap folding station opposite the photo cell **140**. Not until the holding relay coil **2660** is de-energized by opening of the limit switch **135–3**, upon drive of the chain conveyor **59–159** to transport the carton from the sensing and flap folding station forward, will the gate retracting solenoid **197** be permitted again to be energized to permit entrance of the next succeeding carton. This successive periodic energization of the gate retracting solenoid **197** will be effected only when switch **266–1** is permitted to close by the de-energization of relay coil **2660** and the closure again of switch **135–3** by tripping of the limit switch unit **135** when the next lug **66–2** carried by conveyor chain **59** is moved to contact of its trigger **136**.

Upon closure of the "Start" button switch **263** the main motor is started by closure of its A.C. starter switches at **252** resulting from energization of relay **2520**, and this motor is kept running by the simultaneous closure of the switch **252–4** in the shunt circuit about the "Start" button switch, as a result of the energization of this relay coil. An energizing circuit for the solenoid valve **194** is conditioned for operation of the latter initially through the "Start" button switch **263** and then its holding circuit including switch **252–4** which is closed with simultaneous closure of the switches in the A.C. starter **252**, switch **262–3** closed by the energization of relay coil **2620**, and switch **135–2** held closed at the limit switch **135** by the pause of the chain conveyor. The moment that an entering carton is supplied by the conveyor belt **27** to the sensing and flap folding station at "Y" (FIG. 1), to break the beam of light emanating from the light source at **141** directed to the photo cell **140**, the photo cell system **1400** effects closure of switch **140–1** to energize solenoid valve **194** and manipulate it to the position of through flows of FIG. 27, thereby permitting supply of pressurized fluid or air to the pressure switch unit **217** and the back end of the pneumatic cylinder **87** for drive of the clamping rails **80** and **180** inward toward each other to abut opposite sides of the carton at the sensing or flap folding station. The closed switch **135–2** also permits current to flow through conductor **267** to solenoid valve **195** to energize it and obtain the flow paths illustrated in FIG. 27 for supplying the pressurized air to the back end of the pneumatic cylinder **87** for driving the clamping rails **80** and **180** inward toward each other to carton clamping positions. Simultaneously the pressurized air is supplied through energized valve **195** to the front end of the pneumatic cylinder **101** to release the rail driving mechanism clamp **104–108** and thus permit this rail driving action, while supplying the pressurized air to the pneumatic cylinder **119** to extend the clearance arm **116**, so that the carton in the position "Y" will be clamped between the approaching rail flange **81** and this extended clearance arm securely to hold the carton at this station for flap folding operations.

Upon closure of the switch **140–1**, manipulated by the photo cell system **1400** as a result of the presence of the clamped carton at the sensing and flap folding station, current is supplied through the closed head limit switch **149–2** and the closed downward travel limit switch **186–1** to relay coil **2540**. The resulting energization of relay coil **2540** manipulates the switches of the "Down" A.C. starter **254** to closed positions effecting drive of the vertical motion motor **174** to lower the head down to the top of the carton pausing at the sensing and flap folding station. The lowering of the flap folding head **142** and attendant folding back and inward of the upwardly-extending front flap by the arm structure **146** is attended by upward swing of the latter to release the sensing limit switch unit **149**, thus permitting closure of its switch **149–1** in the shunt circuit leading to relay coil **2560** and permitting simultaneous opening of the companion switch **149–2** thereof to de-energize relay coil **2540**. As a result, the switches of the "Down" A.C. starter **254** are permitted to open and stop the motor **174** to discontinue downward drive of the flap folding head **142**. Thus, the

circuit to the relay coil **2560** is readied for closure so that the latter may be energized to release the brake **67–1** by opening switch **257** and engage the clutch **67–2** by closing the switch **258** for initiating drive of the chain conveyor **59–159**.

There was connected in parallel from closed relay switch **135–2** a second circuit for effecting lift of the flap folding head **142**, following this lowering action to the top of the carton and the attendant sensing of the height of the latter. This parallel circuit includes a conductor **268**, in which the photo cell switch **140–2** is located, and closed upward travel limit switch **186–2** leading to relay coil **2530**. The pause of the carton at the sensing of flap folding station caused interruption of the light beam emanating from the light source at **141** to discontinue impingement thereof on photo cell **140**, so that the resulting de-excitation of the latter caused opening of the photo cell switch **140–2** as photo cell switch **140–1** was closed. Thus, the energizing circuit of relay coil **2530** is readied for energizing the latter. Upon withdrawal of the carton from the sensing or flap folding station by the driven chain conveyor **59–159**, to permit impingement of the light beam from light source **141** again upon the photo cell **140** for exciting the latter, switches **140–1** and **140–2** are manipulated by the photo cell system **1400** to the positions indicated in FIG. 28 for effecting energization of relay coil **2530**. The energization of relay coil **2530** causes it to close the switches of the "Up" A.C. starter **253** to effect reverse drive of the vertical motion motor **174**, so that the latter will lift the flap folding head **142** until the vertical travel limit switch **186–2** is opened by engagement of the switch trigger **187** with the limit collar **193**. The lift of the flap folding head **142** frees the front flap folding arm structure **146** from engagement of the carton top to permit it again to swing down to the depending position shown in full lines in FIG. 1, thereby tripping the limit switch unit **149**, again to open the switch **149–1** and close the switch **149–2**, so as to ready the circuitry for again lowering the flap folding head in the next cycle of operation on the succeeding carton.

As has been previously explained, when the clamping and guiding rails **80** and **180** are driven inwardly to engage flange **81** of the former and extended clearance arm **116** of the latter to opposite sides of the carton at the sensing and flap folding station the supply of pressurized air to the back end of pneumatic cylinder **87** is prevented from driving its piston **88** forward, but the pressurized air is continued to be supplied straight through energized solenoids **195** and **194** to the pressure switch unit **217** so as to build up the pressure in the latter to ultimate closure of the pressure switch **218**. Upon closure of the pressure switch **218** relay coil **2560** is energized to open the magnetic brake circuit at switch **257** and close the magnetic clutch circuit at switch **258** to effect the drive of the chain conveyor **59–159**. The resulting travel of the chain conveyor **59–159** drags the limit switch trip lug **66–1** from beneath trigger **136** of the limit switch **135**, thus permitting its held open switch **135–1** to close with simultaneous opening of its switches **135–2** and **135–3**. Since switch **262–3** is held closed by continued energization of relay coil **2620** a holding circuit, shunted around head limit switch **149–1** and pressure switch **218**, is completed through closed switches **262–3** and **135–1** to maintain the energization of relay coil **2560** for continuing the closure of the magnetic cluch circuit switch **258** while the magnetic brake circuit is continued to be held open at switch **257**. This condition is continued until the following trip lug **66–2** carried by conveyor chain **59** moves forward to drag beneath the trigger **136** of the limit switch **135** to effect opening of the holding circuit to relay coil **2560** at the limit switch **135–1**, as will be understood from FIG. 28.

The drive of the chain conveyor **59–159** ultimately caused the next successive carton pick up flight **64** thereof to move in behind the carton "Y" pausing at the sensing and flap folding station and pick it up for forward transportation therefrom. The withdrawal of the carton from the sensing and flap folding station by the chain conveyor **59–159** and its next following flight **64** brought to abutment of the back edge of the carton is accompanied by the de-energization of both solenoid valves **194** and **195** effected by the opening of the limit switch **135–2**. As was explained in connection with FIG. 27, a flow passage through de-energized solenoid valve **194** is thus readied for later supply of pressurized air to the opposite end of the pneumatic cylinder **87**, so that the latter can reversely drive the rail operating mechanism at a future time to retract the latter from each other for free reception of next carton therebetween, and the pressure switch unit **217** is vented back therethrough again to open the pressure switch **218** for readying the energizing circuit of relay coil **2560** for the successive cycle. The simultaneous de-energization of solenoid valve **195** reverses the flow passage therethrough so that no pressurized air is being supplied to solenoid valve **194**, and the pneumatic cylinder **119** and the front end of pneumatic cylinder **101** are vented back through de-energized solenoid **195**. Pressurized air is thus supplied through the latter to the back end of clamp operating pneumatic cylinder **101** to apply the clamp **104–108** to the rail driving mechanism, thereby holding the rails **80** and **180** in their inward positions. The simultaneous venting of the pneumatic cylinder **119** withdraws forward thrust from the clearance arm **116** so that now the carton may be freely transported forward between the rails **80** and **180** in the inward positions of the latter, so that these rails will cooperatively provide means to guide the carton in its forward travel toward the discharge end of the machine.

As soon as the next oncoming tripping lug **66–2** of the driven chain conveyor **59–159** closes the switch **135–2** of the limit switch unit **135** the circuit of solenoid valve **195** again becomes energized to repeat the supply of pressurized air to the pneumatic cylinder **119** for extension of the clearance arm **116** thereby and to supply the pressurized air to the head end of pneumatic cylinder **101** to release the rail driving mechanism clamp **104–108**. However, de-energized solenoid valve **194** now dictates supply of the pressurized air (flowing through energized solenoid valve **195**) across therethrough to the front end of pneumatic cylinder **87**, so as to retract the guiding rails **80** and **180** transversely away from each other to their initial carton-receptive positions depicted in FIG. 2. Only when the next oncoming carton is supplied to the sensing and flap folding station to effect closure of the photo cell switch **140–1** will solenoid valve **194** be again energized to drive the clamping rails **80** and **180** inward toward each other to abutment of opposite sides of this next carton. Then the energizing circuit of relay coil **2540** will again be closed at this photo cell switch **140–1** for the next cyclic lowering of the flap folding head **142**.

For this repeat operation the selector gate **12** must be retracted or lowered to permit entrance of the next oncoming carton, at "Z," so that it may be fed by the conveyor belt **27** to the sensing and flap folding station at "Y." As was explained in connection with FIG. 26, solenoid valve **197** must be energized for this purpose. Its energizing circuit includes a conductor **269** in which is connected in series switches **262–5**, **135–3** and **266–1**. Normally open switch **262–5** was closed by the initial energization of relay coil **2620**, resulting from closure of the size switch **259** when the latter was manipulated to its "Random" setting **260**. Switch **135–3**, which is biased toward open position, was closed by the tripping of trigger **136** of limit switch **135** when engaged by the next tripping lug **66–2** on the conveyor chain **59**. Switch **266–1** is one of a pair of switches (the other being **266–2**) controlled by a relay coil **2660**. Switch **266–1** is biased closed while its companion switch **266–2** is biased open, and upon energization of relay coil **2660** the first will be

opened and the second closed. Thus, before relay coil **2660** is energized the solenoid valve **197** will be energized and its energization continued, so as to hold the selector gate **12** down or retracted until its energizing circuit is broken at switch **266–1** by the energization of relay coil **2660**, during such time as switch **135–3** is held closed by the trip of limit switch **135** when its trigger **136** is engaged by the conveyor chain lug **66–2**. This closure of limit switch **135–3** is maintained while the chain conveyor **59–159** is not being driven and during the initial increment of each following periodic drive thereof as either of the tripping lugs **66–1** and **66–2**, carried thereby, is being dragged beneath trigger roller **137** of limit switch unit **135**. The length of each of the tripping lugs **66–1** and **66–2** bears a relation to the minimum size of cartons to be effectively closed in any particular embodiment of the machine.

With switches **262–5** and **135–3** closed, the closure of switch **138–1** (by de-excitation of the photo cell **138** with the breaking of the light beam from light source **139** by advance of a carton across the retracted gate **12**) effects energization of relay coil **2660**. The energization of relay coil **2660** closes its switch **266–2** and opens its switch **266–1**, thereby de-energizing the gate retracting solenoid **197**, so that the pneumatic cylinders **18** lift the gate as this carton is gliding forward over the gate roller **17** to the conveyor belt **27**. As this fed carton passes beyond photo cell **138** the photo cell switch **138–1** is again opened, but the energization of relay coil **2660** is maintained by a holding circuit shunted around this photo cell switch which includes closed relay switch **266–2**. Thus, the energization of relay coil **2660**, to continue the de-energization of solenoid valve **197**, is maintained until the energizing circuit of this relay coil is broken by the opening of switch **135–3** as one of the tripping lugs **66–1** and **66–2** is dragged from beneath the trigger **136** of limit switch unit **135**. Accordingly, the selector gate **12** remains raised to its corton-barring position so long as the relay coil **2660** remains energized.

As was previously explained in connection with FIG. 25, the back flap kicker **161** is swung down to strike the top edge of the upwardly-extending rear top flap and fold it forward down to the horizontal plane of the open top of the carton when the solenoid valve **198** is energized. The energizing circuit of solenoid valve **198** includes in series physical sensing switch **128**, which is normally biased to closed position, and normally open switch **256–1**, which is closed only when relay coil **2560** is energized. Since a carton must be present at the sensing and flap folding station "Y" in order for the lowering of the head **142** to close the switch **149–1** as the front flap folding arm structure **146** effects its folding operation with upward swing to its lateral position, and this carton must be clamped thereat between the clamping rails **80** and **180** in their inward positions to cause a sufficient build up of pressure of the pressurized air fed to pressure switch unit **217** to effect closure of the pressure switch **218** in order initially to energize relay coil **2560**, the closure of switch **256–1** is attained only after these conditions are satisfied. The closure of switch **256–1** is then maintained by the shunt circuit which includes limit switch **135–1**, the latter being closed only as the chain conveyor **59–159** is driven to drag one of its tripping lugs **66–1** and **66–2** from beneath the trigger **136** of limit switch unit **135**. Now, if during any such time of maintenance of closure of the relay switch **256–1** physical sensing switch **128** is permitted to attain its normally closed position, the solenoid valve **198** will be energized to swing the kicker **161** down for folding the back flap. Since the presence of a carton at the sensing and flap folding station and its clamping between the rails **80** and **180** causes retraction of the operating arm **129** of sensing limit switch **128**, this carton must be moved forward beyond the latter by travel of the chain conveyor **59–159** and the pick up of the carton by the following flight **64** thereof to release the sensing switch operating arm **129** to effect the energization of solenoid valve **198** and operate the kicker **161**. Consequently, the back flap of the carton open top will be folded down to closed position only while the carton is being transported forward from the sensing and flap folding station "Y" beyond the physical sensing means comprising switch **128** and its operating arm **129**. This back flap kicker **161** then remains down, with its bottom face **173–2** substantially in the plane of the bottom face **146–1** of the upwardly swung lateral front flap folding arm structure **146**, until the limit switch unit **135** is again tripped by the next following lug **66–2** carried by conveyor chain **59** for opening the holding circuit of relay coil **2560** at the switch **135–1**. The resultant de-energization by the opening of the switch **256–1** causes the solenoid valve **198** to be de-energized, so as to reverse the flow passages therethrough and supply the pressurized air to the back end of pneumatic cylinder **163** to cause the kicker **161** to be swung back up to its cocked position shown in full lines in FIG. 1.

RANDOM OPERATION

An embodiment of the machine of the present invention, when of the construction illustrated in the drawings and equipped with electrical and pneumatic systems diagrammatically depicted in FIGS. 25 to 28 incl., will operate as follows when a series of cartons of random size are fed to the entrance end thereof by the supply conveyor **9**. The size switch **259** is set to its "Random" position **260** and the "Start" push button **263** is pushed to drive the main motor **51**. There are no cartons in the machine and while the belt conveyor **27** is being driven continuously the chain conveyor **59–159** is held stopped by the magnetic brake **67–1** with the limit switch **135** tripped. As a result, the gate operating solenoid valve **197** is energized and holds the selector gate **12** retracted for entrance of the first carton at the position "Z" in FIG. 1. At this time, the vertical motion motor **174** is undriven and the flap folding head **142** is in its top position, and the back flap kicker **161** is in its cocked position. The guide rails **80** and **180** are in their carton-receptive retracted positions.

As the leading edge of the bottom of the carton at "Z" enters over the retracted selector gate **12**, the beam of light from the light source **139** which impinges upon the photo cell **138** is interrupted. Consequently, the selector gate **12** is raised to lift its roller **17** beneath the bottom of the entering carton which permits the latter to glide forward onto the driven conveyor belt **27** while positioning the carton-barring gate flange **16** into the path of the next oncoming carton supplied by feed conveyor **9**. The driven conveyor belt **27** transports this first carton forward to between the retracted guide rails **80** and **180** and on to the sensing and flap folding station at the position "Y" until the front end of the carton is brought to abutment of the stop flight bar **164** carried by the pausing chain conveyor **59–159**. As the carton was fed to this sensing and flap folding station it interrupted the beam of light emanating from the light source **141** to block off impingement thereof on the second photo cell **140**. As a result of this interruption of the light beam which impinged upon the photo cell **140**, the guide rails **80** and **180** are caused to be driven inward toward each other to abut the flange **81** of the former and the extended clearance arm **116** of the latter to opposite sides of the carton and clamp it at this station. Thus the near side of the carton is forced against the near side rail flange **81** and the far side of the carton is in firm contact with the extended clearance arm **116** while being held by the latter a fraction of an inch out of contact with the flange **181** of the rail **180**. Pressure is then built up in pressure switch **217** to close the pressure switch **218** for conditioning the release of the chain conveyor **59–159** by the mag-

netic brake **67–1** and drive thereof by the magnetic clutch **67–2**.

The interruption by the carton of the beam of light impinging on photo cell **140** at the sensing and flap folding station "Y" also initiates the drive of the vertical motion motor **174** to lower the flap folding head **142** down over the open top of the carton pausing at this station. As the flap folding head **142** is lowered its depending front flap folding arm structure **146** engages the upwardly-extending front flap and folds it back down to the horizontal plane of the top of the carton body with attendant upward swing of this flap folding arm structure. Attendant release of the limit switch **149** on the flap folding head **142** stops the downward motion of the latter, so that switch **149–1** is released to permit the energizing circuit of the chain conveyor actuating means to be closed when pressure build-up closes the pressure switch **218**.

With the front flap of the carton top folded down to closed position, the closure of the pressure switch **218** will cause the magnetic brake **67–1** to be de-energized for release of the chain conveyor **59–159** and the magnetic clutch **67–2** to be engaged, so as to initiate drive of the chain conveyor for ultimate transport of the partially closed carton forward from the sensing and flap folding station at "Y." This forward drive of the chain conveyor **59–159**, before the partially closed carton is picked up by the next oncoming flight bar **64** thereof, releases the limit switch **135**. As a result, the sensing portion of the machine is de-energized by the attendant opening of the master control switch **135–2** while the clamp **104–108** is applied to the mechanism which drives the rails **80** and **180** transversely so as to hold them in their inward positions. Release of the limit switch **135** also relieves the biasing of the clearance arm **116** so that the carton is no longer clamped at the sensing and flap folding station but released for forward transport therefrom by the traveling chain conveyor between the rails **80** and **180** now serving as guides for the carton. The drive of the chain conveyor withdraws the stop flight bar **164** from in front of the partially closed carton, and continues eventually to carry its next following flight bar **64** forward to the back end of the partially folded carton, to pick up the latter and transport it forward.

While the carton was pausing at the sensing and flap folding station "Y" it held the sensing arm **129** depressed, so that the rear flap kicker **161** was maintained in its extended cocked position. As soon as the partially closed carton is picked up by the oncoming flight bar **64** of the chain conveyor **59–159** at the sensing and flap folding station and carried forward beyond the retracted physical sensing arm **129**, the latter is released so that the cocked kicker **161** will be swung down, sharply to strike the rear side of the upwardly-extending back flap and fold it forward down to the plane of the folded front flap as the carton is being transported forward. These folded front and back flaps are then maintained in their folded positions as the carton travels forward further both by the lateral bottom surfaces **146–1** and **173–2** of the front folding flap arm structure **146** and the kicker **161**, as well as by the presser plate **150**. During this forward travel of the partially closed carton, the plows **233** and **333**, carried by the flap folding head **142**, engage the outer sides of the upwardly-extending side flaps and gradually turn the latter over and downward toward each other for stacking upon the folded front and back flaps, thereby completing the closure of the carton top.

Thereafter, the lapped and folded top flaps may be secured in any desired way, such as by applying tape thereto from the top taping unit comprising head beam "A," and the tape applying devices "B" and "C" and the tape supply reel "D" carried thereby.

The driven chain conveyor **59–159** then carries the closed carton forward to the discharge end of the bed unit **1** of the machine for delivery, and the chain conveyor is then ultimately stopped by engagement of its next oncoming tripping lug **66–2** with the trigger **136** of the limit switch **135**. The tripped limit switch **135** causes the relay coil **2560** to be de-energized so as to release the magnetic clutch **67–2** and apply the magnetic brake **67–1** to hold the chain conveyor **59–159** in the stopped position illustrated in FIG. 1. The tripped limit switch **135** also activates the sensing units, recocks the kicker **161**, causes the vertical motion motor **174** by reverse operation to raise the flap folding head **142** to its initial position, releases the rail driving mechanism clamp **104–108** and retracts the guide rails **80** and **180** to their initial carton-receptive positions, biases the clearance arm **116** outward from rail flange **181** and lowers the selector gate **12** to permit the entrance of the next oncoming carton stopped at the position "Z." If there is no succeeding carton at the position "Z," ready for entrance into the machine, the latter will remain readied to accept any supplied carton at any time thereafter for a repetition of the cycle of operation.

It will thus be seen that the limit switch **149** on the flap folding head which, with its operator in the form of front flap folding arm structure **146**, constitutes physical sensing means to sense the height of a carton at the sensing and flap folding station, controls the drive of the chain conveyor **59–159** and the lowering action of the flap folding head **142**. This sensing means responds to the vertical dimension of the carton body. It also acts through the chain conveyor drive controlling relay **2560** and its switch **256–1** to cooperate with carton width sensing switch **128** for controlling the actuation of the rear flap folding arm or kicker **161**, so that the latter is swung down to effect its folding operation only when the chain conveyor **59–159** is driven and the partially closed carton is being withdrawn by the latter from the sensing and flap folding station sufficiently to free the actuating arm **129** of sensing switch **128** to permit the latter switch to close. The second sensing means comprising switch **128** and its actuating arm **129**, and rail **180** carrying them in cooperation with the opposed rail **80**, is also of the physical type to respond to the transverse dimension or width of the carton body. The limit switch **135** which is operated by the conveyor chain **59** by means of trip lugs **66–1** and **66–2** carried thereon constitutes other control means which, in cooperation with optical sensing means at the sensing and flap folding station in the form of photo cell system **1400**, dictates continuation of initiated drive of the chain conveyor **59–159**, the transverse inward drive and retraction of carton clamping and guide rails **80** and **180** and the holding thereof to their inward carton-clamping positions, the elevational travel of the flap holding head **142**, the extension of clearance arm **116** and the freeing of the latter, and the alternate retraction and lift of the selector gate **12**. However, the effectiveness of the dictation of the entire manipulation of the selector gate **12** is dependent upon response of the other optical sensing means in the vicinity of the latter, in the form of photo cell system **1380**, to the presence of a portion of a carton being fed across the gate to the conveyor means. Thus, there are a pair of physical carton sensing means comprising limit switches **149** and **128** and their associated carton-contacting operators, a pair of optical carton sensing means comprising photo cell systems **1400** and **1380**, and a conveyor manipulated master control comprising limit switch **135** and its operating means.

In the event that, during such carton-closing operation of the machine, one of the cartons in the machine is found by the actuator to be damaged or initial partial closure thereof to be improper it may be quickly and readily freed from the machine without stopping the latter by manipulating a release switch unit **271**. Release switch unit **271** comprises a bank of switches **272**, **273**, **274** and **275** which are simultaneously manipulated. The resulting opening of normally closed switch **272** in conductor **268** and simultaneous closing of switch **273** in a conductor **276**, constituting a shunt energizing circuit leading to the re-

lay coil **2530** which causes lift of the flap folding head **142**, immediately raises the latter to its initial elevated position above such a carton if it is pausing at the sensing and flap folding station with the chain conveyor stopped. The accompanying opening of the switch **274** with simultaneous closing of switch **275** in a conductor **277**, constituting a shunt energizing circuit leading to the solenoid valve **195**, releases the carton clamping clearance arm **116** as the clamp **104–108** is applied to the rail driving mechanism. The application of clamp **104–108** prevents the rails **80** and **180** being driven in further toward each other for grip of the carton between the rail flanges **81** and **181**.

CONDITIONING OF CIRCUITRY FOR "UNIFORM" OPERATION

The machine is set up for "Random" operation, as previously described, and the first of a group of cartons of uniform size to be closed successively by the machine is fed thereto in the same manner. Thus, when this first carton is delivered to the sensing and flap folding station, at "Y," its presence causes the photo cell system **1400** to close switch **140–1** and open switch **140–2**. Consequently, the flap folding head **142** is brought down to the top of the carton to fold the front flap back and inward, and to condition the energizing circuit of relay coil **2560**, so that the latter may open the brake circuit at switch **257** and close the clutch circuit at switch **258**. The solenoid valve **195** was energized by the tripped limit switch **135** and the closure of switch **140–1** now energizes solenoid valve **194**, so that pressure fluid is supplied successively through these solenoid valves to cause pneumatic cylinder **87** to move the clamping rails **80** and **180** inwardly to clamping positions on opposite sides of the carton. With eventual closure of pressure switch **218** relay coil **2560** is energized to open the brake circuit at switch **257** and close the clutch circuit at switch **258**, thereby causing the chain conveyor **59–159** to be driven. The drive of the chain conveyor **59–159** removes the tripping lug **66–1**, carried thereby, from beneath the trigger **136** of this limit switch, so as to open at switch **135–2** the circuits to the solenoid valves **194** and **195**, causing the latter to effect clamping of the rails **80** and **180** to their inward positions. As was previously explained, this also released the clearance arm **116** by venting the pneumatic cylinder **119**, so that successive cartons of the same size may freely pass between the inwardly positioned and clamped rails.

The machine also was manually conditioned initially for successive closing operations on the series of uniform size cartons thereafter fed through it. For this purpose the latch plate **154** was slid back on the front flap folding lever arm structure **146**, so that as the latter is swung up in the folding down of the front flap of the first carton during the lowering of head **142** the spring-biased detent **153** is snapped up over the retracted latch plate to lock this arm structure up to its lateral position, for drag therebeneath of the upwardly-extending front flaps of all succeeding cartons of uniform size to fold them down to closing positions. At any time before the next following tripping lug **66–2** on the conveyor chain **59** arrives again to trip the limit switch **135** the machine may be finally conditioned for the uniform operation by positioning the size switch to the "Uniform" setting which opens the energizing circuit of relay coil **2620**.

With the de-energization of relay coil **2620**, the circuit connections controlled thereby are reversed. Thus the photo cell systems **1380** and **1400** are de-energized by opening the switch **262–1**. Switch **262–2** is thus permitted again to close so as to maintain energization of relay coil **2560** to open switch **257** for brake release and close switch **258** for continuous drive of the chain conveyor **59–159**. Also, switch **262–3** is permitted open. The biased open condition of switch **262–3** prevents electrical energy from being supplied to the branch circuits leading to the equipment for effecting raising and lowering of the flap folding head **142** and solenoid valves **194** and **195**, even when limit switch **135–2** momentarily is closed by the engagement of the trigger **136** of the limit switch **135** with each of the conveyor chain-carried lugs **66–1** and **66–2** as it passes. Thus, de-energized solenoid valve **194** remains conditioned for supplying pressure fluid at some future time, after this "Uniform" operation is discontinued, to the bottom end of the pneumatic cylinder **87** (FIG. 27) for retracting the clamping rails **80** and **180**. The continued de-energization of solenoid valve **195** maintains the application of clamp **104–108** to the mechanism which drives the clamping rails **80** and **180** in and out, to retain these rails in their inward carton guiding positions.

Since the switch **128** is biased closed and temporarily held open by depression of the arm **129** of this physical sensing switch upon passage of a carton through the sensing station at "Y," again to be biased closed after the carton has passed through the latter, the solenoid valve **198** will be energized through closed switch **256–1** upon biased closure of switch **128** and de-energized upon opening of the latter as a passing carton depresses its operating arm **129**. The back flap folding kicker **161** is swung down from its cocked position by the energization of solenoid valve **198** and it is swung back up to its cocked position when this solenoid valve is de-energized. Thus, as each carton of uniform size is fed to the flap folding station "Y" (with the sensing equipment of the latter deactivated), the opening of switch **128** by its operating arm **129** as the latter is depressed by the passing carton with de-energization of solenoid valve **198** causes the back flap folding kicker **161** to be swung back up to cocked position, and soon thereafter, when switch **128** is released to closed position, the consequential energization of solenoid valve **198** causes the cocked kicker **161** to be swung down to fold the extending back flap forward and inward to closed position as the carton is moved forward. The kicker **161** remains in its down position until switch **128** is again tripped open by the approach of the next carton to the flap folding station "Y."

The selector gate operating solenoid valve **197** when energized pulls down or retracts the entrance gate **12** to permit a carton to advance to the continuously driven conveyor belt **27**, and when it is de-energized it lifts the gate temporarily to bar entrance of the succeeding carton. Solenoid valve **197** is provided with a shunt energizing circuit which includes conductor **278** having therein switch **262–4** that is biased closed when relay coil **2620** is de-energized on the "Uniform" setting **261** of the size switch **259**, and a switch **235** in series therewith. As was previously pointed out, switch **235** is similar to limit switch **135** and is operated or tripped by a series of trip lugs (which may be similar to **66–1** and **66–2**) carried by the far chain **159** of the chain conveyor, each associated with one of the flights **64** of the latter. Thus, as each flight **64** passes switch **235** it will be closed momentarily to energize solenoid valve **197** and cause the latter to lower entrance gate **12** for permitting entrance of the next succeeding carton to the conveyor belt **27** and pick-up by the next arriving flight **64** of the chain conveyor **59–159**.

UNIFORM CARTON SIZE OPERATION

As a result, operation of the machine on "Uniform" setting is as follows. By passing the first of a number of cartons of uniform size through the machine on "Random" setting **260** of size switch **259** the clamping rails **80** and **180** are caused to be moved inwardly to sense the carton at the sensing and flap folding station "Y" and the flap folding head **142** is moved down to sense the top of the carton thereat. Then, when the size switch **259** is shifted to the "Uniform" setting **261** to open the circuit of relay coil **2620**, the machine is conditioned for continuous operation of the chain conveyor **59–159** with the

clamping rails **80** and **180** secured to their inward, carton-guiding positions, and the flap folding head **142** is held down to the adjusted position at the plane of the top of the bodies of the cartons, with the front flap folding arm structure **146** latched to its horizontal position. The entrance gate **12** is pulled down by the energization of its operating solenoid valve **197**. As a result, the next following carton of uniform size is permitted to travel over the retracted entrance gate **12** to the continuously driven conveyor belt **27**.

This second carton of uniform size is transported forward by the belt conveyor **27** to the flap folding station "Y" and, during this travel, its extending front flap moves against the oblique shoe provided by presser plate nose **250** to be folded back and inward by drag beneath it and the latched horizontal front folding flap arm structure **146** and the presser plate **150**. Since the chain conveyor **59–159** is also continuously driven its next flight **64** follows immediately behind this second carton as it is fed forward to the flap folding station "Y" to pick it up and carry it forward on through the machine. As this second carton approaches the flap folding station "Y," the far side thereof drags against the trip arm **129** of the sensing switch **128** to open this switch and de-energize the solenoid valve **198**, thereby cocking the kicker **161** up to horizontal position. As soon as the continued forward transportation of this second carton frees the latter from the switch trigger **129** switch **128** is again permitted to close to re-energize solenoid valve **198** and swing the kicker **161** down to fold the extending back flap of the moving carton forward and inward to the horizontal plane of the folded front flap, so that both will be dragged successively in folded conditions beneath the latched arm structure **146** and the presser plate **150** of the lowered head **142**. During this latter action, the side flaps will be folded inward by the plow rods **233** and **333** to lap over the folded front and back flaps. This closed second carton is then carried further forward to beneath the taping unit on the far end of the head **2** (or to any equivalent flap-securing means) securely to anchor the folded flaps in their folded positions, the continuously operating chain conveyor **59–159** then transporting the closed carton to the discharge end of the machine.

Since the chain **159** on the far side of the chain conveyor is equipped with a series of switch tripping lugs, each associated with one of the flights **64** of this conveyor, and the biased open switch **235** is tripped closed during the passage of each such lug, the solenoid valve **197** will be momentarily energized through closed relay switch **262–4** to lower the entrance gate **12** and permit the next succeeding carton of uniform size to move thereover onto the conveyor belt **27** for repetition of the action. The length of each of these switch tripping lugs on the far chain **159** is of a length sufficient to hold the entrance gate **12** down for a short period of time that is long enough to permit the leading bottom edge of the next succeeding carton to advance over the entrance gate before it is again lifted by de-energization of the gate operator solenoid valve **197**.

The lift of the entrance gate **12** does not have to be delayed until the next succeeding carton has traveled completely over and beyond the gate in its depressed or retracted position, but merely long enough to permit the leading bottom edge to enter over it since, thereafter, even though the gate be raised again beneath the bottom of this carton while it is traveling forward to the conveyor belt **27**, it will continue its forward travel to the latter over the gate roller **17** and by virtue of the nature of the initial feed, which may include forward push by following cartons. Thus, the entrance gate **12** drops down every time a flight bar **64** of the conveyor chain **59–159** passes to accept the next succeeding carton of uniform size.

On the "Uniform" setting of the machine cartons of uniform size can be closed thereby at a production rate of many times that of the "Random" setting, and in the machine illustrated in the drawings, this increased production rate will be four times that of the production rate for the "Random" setting and operation.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In an automatic carton closing machine for folding down and inward the upwardly-extending front and rear flaps of a series of successive open-top cartons of random size to closed lateral lapping positions for securing the folded flaps of each together in carton closing positions the combination with lateral conveyor means having an entrance end and a discharge end and defining a path of forward carton travel along which said conveyor means transports each carton, a flap folding and sensing station located at a point along said path, means to cause each open-top carton to pause at said station, a movable front and rear flaps closing head mounted for motion along a path at an angle to said carton travel path toward and away from the open top of a carton pausing at said station, carton sensing means at said station responsive to the presence of an open-top carton pausing at said station to dictate advance of said head toward the unfolded and upwardly-extending flaps thereof and to fold back and inward to closing position the front flaps, carton height control means at said station responsive to the top of said carton to stop the head advance upon inward folding of the front flap down upon the carton top, means to release said pausing carton from said station for transport by said conveyor means toward the discharge end, and movable rear flap folding means carried in readied and non-operating condition by said head for location at a relatively fixed position along the carton travel path when said head aproaches the open carton top to infold the front flap, said rear flap folding means in this relatively fixed position being adapted when activated to fold forward and inward said unfolded and upwardly-extending rear flap of the carton top when said unfolded rear flap is in the immediate vicinity of the relatively fixed position, of means to sense the location of said unfolded and upwardly-extending rear flap in this vicinity as the carton is carried forward therepast by said conveyor means and activate said rear flap folding means for folding said rear flap forward and down in properly timed relation as this flap is passing this flap folding means.

2. The automatic carton closing machine as defined in claim **1** characterized by said rear flap location sensing means comprising control means movable transversely inward to abutment of an opposed side of the carton pausing at said station which has its rear edge located in predetermined relation to the unfolded upstanding rear flap along the path of carton travel, said control means dictating activation of said rear flap folding means as the rear edge of said abutted carton side is withdrawn from abutting relation to said control means in renewed forward transportation of the carton from said station by said conveyor means.

3. The automatic carton closing machine as defined in claim **2** characterized by carton width sensing means at said station having opposed and transversely-spaced guide means between which the carton pauses at said station, one of said guide means carrying said control means and

being movable transversely inward to abut said control means to the opposed carton side.

4. The automatic carton closing machine as defined in claim 3 characterized by said opposed and transversely-spaced guide means constituting clamping means at said sensing station to clamp each carton temporarily thereat during the advance of said head toward the top thereof and the inward folding of said front flap, said conveyor means releasing said clamping means thereafter.

5. The automatic carton closing machine as defined in claim 1 characterized by said conveyor means including a pair of successive sections with a continuously driven initial section at the entrance end to feed supplied cartons successively to said sensing station, and a periodically driven succeeding section successively to pick up the cartons at said sensing station and carry them forward therefrom, said succeeding conveyor section activating said means causing each carton to pause at said sensing station when said succeeding section is undriven.

6. The automatic carton closing machine as defined in claim 5 characterized by closed entrance gate means located ahead of said continuously driven initial section of said conveyor means which temporarily bars entrance thereto of an open carton, means to prevent opening of said gate means while a preceding carton is at said sensing station for performance thereon of the front flap folding operation, and means activated by the start of said periodically driven succeeding conveyor section to open said gate for entrance to said initial conveyor section of the succeeding carton, said gate opening means manipulating said gate to its carton entrance barring position before the following carton arrives thereat.

7. The automatic carton closing machine as defined in claim 5 characterized by means rendering said carton presence sensing means effective to advance said head to the open top of the carton at said sensing station, activatable means manipulated by said carton presence sensing means to retract said head to its initial position, and means to activate said head retracting means operable by renewed drive of the succeeding conveyor section after the latter removes the carton from said sensing station.

8. The automatic carton closing machine as defined in claim 4 characterized by said clamping means being in the form of a pair of opposed longitudinally-extending and laterally movable guide rails extending through said sensing station and forward past said flap folding means for centered guidance of each carton therebetween, at least one of said rails carrying on its inner face at said sensing station in inwardly extendable and outwardly retractable carton side engaging clearance member, means to extend said clearance member inward and move at least one of said rails inward toward the other to clamp said carton at said sensing station between said extended clearance member and the opposed guide rail, and means to permit retraction of said extended clearance member to free said carton for forward transport by said conveyor means between the inwardly positioned rails as guides while the latter are maintained in their opposed relatively inward positions, and means operated by drive of said conveyor means to manipulate said retraction permitting means.

9. The automatic carton closing machine as defined in claim 8 characterized by said means which moves said rails inward to carton clamping positions alternately being adapted to retract said rails outward to initial carton receptive positions, and means activated by said conveyor means to operate said rail retracting means before arrival of a succeeding carton at said sensing station.

10. The automatic carton closing machine as defined in claim 1 characterized by said head being mounted above said conveyor means for travel down to the top of an open carton at said sensing station and then lift back up to an initial higher position, means alternately to lower and lift said head, and opposed fixed plows converging toward the central portion of the path of carton travel in the forward direction of the latter carried by said head to engage outer sides of the upwardly extending side flaps as the carton is transported further forward by said conveyor means with its front and rear flaps folded down to turn said side flaps in and down over the folded front and rear flaps.

11. The automatic carton closing machine as defined in claim 1 characterized by the provision of head elevating mechanism alternately to lower said head to the open top of a carton at said sensing station and lift it up therefrom, said conveyor means having an alternately driven and undriven forward section extending from said sensing station, conveyor driving mechanism alternately to drive and stop said conveyor section, and limit means manipulated by said conveyor section to permit when the latter is undriven, said head elevating mechanism to operate when the presence of a carton pausing at said sensing station is sensed, said carton top sensing means controlling operation of said conveyor driving mechanism to start and drive said conveyor section after a period of stop thereof.

12. The automatic carton closing machine as defined in claim 11 characterized by said limit means including means to deactivate said head elevating mechanism during drive of said conveyor forward section.

13. The automatic carton closing machine as defined in claim 12 characterized by said limit means including means to deactivate said conveyor forward section driving mechanism after a period of drive of said conveyor section.

14. The automatic carton closing machine as defined in claim 13 characterized by entrance gate means located at the entrance end of said conveyor means which bars entrance of a succeeding open carton while a preceding carton is pausing at said flap folding and sensing station, and means to open said gate to permit entrance of the succeeding carton and then to close it before arrival of the next following open carton, said limit means including means to manipulate said gate opening and closing means for opening and holding open said gate when said conveyor forward section is undriven and in the absence of carton structure between said gate and sensing station, and for urging said gate toward closed position upon entrance of at least a portion of a carton beyond the latter.

15. The automatic carton closing machine as defined in claim 14 characterized by said gate manipulating means including gate operation carton sensing means located between said gate and sensing station to deactivate said gate opening means in response to passage of carton structure past this carton sensing means to permit said gate to be urged toward closed position.

16. The automatic carton closing machine as defined in claim 8 characterized by means to manipulate said rear flap folding means, and a device alternately to activate and deactivate said last-mentioned manipulative means, said device being movably mounted on one of said clamping and guiding rails at said sensing station for adjustable motion longitudinally of said rail and including said control means to abut a side of a carton when the latter is clamped between said rails at said sensing station for deactivating said manipulative means, said carton side abutting control means being disengaged from the carton side when said carton is transported forward from said sensing station to activate said manipulative means for flap folding operation of said folding means, said device being tethered by a swinging tie to fixed structure whereby when a narrower carton is clamped between said rails said device is adjusted to a further advanced position along the carton path than when a wider carton is clamped therebetween to effect the flap folding operation for shorter rear flaps at a point of further advance of the carton.

17. In an automatic carton closing machine the combination with a pivoted flap folding arm retracted upwardly at a flap folding station along a path of forward

transportation of an open top carton to swing forwardly down and strike the back side of an upwardly extending rear top flap of the carton for folding said flap forward down to a lateral closing position, movable carton guide means arranged along said path, and mechanism to move said guide means transversely inward to adjacency of a side of the carton at said station, of flap folding control means movably supported on said guide means for adjustable travel along the path comprising means to dictate alternate upward retraction of said pivoted flap folding arm and downward flap folding swing, means for actuating said dictating means extending from the inward side of the latter to be brought to contact of the opposed side of the carton at said station by transverse inward motion of said guide means to effect an actuation of said dictating means with a second actuation of the latter being effected upon being freed from contact with the opposed side of the carton, one of the two actuations of said dictating means initiating flap striking downward swing of said folding arm, and substantially rigid elongated tie means pivotally anchored at one end to relatively fixed structure and at the other end to said dictating means to cause the latter to be moved forward on said guide means with transverse inward motion of the latter to adjacency of the carton side whereby said dictating means is advanced forward along the path a distance proportionate to the width of the carton.

18. The apparatus defined in claim **17** wherein mechanism is provided to transport the carton forward from said station along the path to free its side from said actuating means contacting it and effect the second actuation of said dictating means.

19. The apparatus defined in claim **18** wherein said guide means moving mechanism retracts the guide means transversely outward to an initial position permitting free delivery of cartons of maximum width to said station and the subsequent transverse inward motion to adjacency of the opposed side of any particular carton delivered to said station, said tie means pushing said control means back along said guide means to an initial rearward position upon retraction of said guide means.

20. The apparatus as defined in claim **19** characterized by said dictating means being an electrical circuit switch unit, longitudinally-extending switch unit guiding means mounted on said carton guide means slidably supporting said switch unit thereon, said switch unit actuating means being biased to an outer position in which it extends inward from said switch unit beyond the inner side of said guide means first to contact an opposed carton side as said guide means is moved transversely inward to the carton side, said biased actuating means being depressed by movement of said guide means to contact of the carton side to effect the first switch actuation of one of alternate opening and closure switch manipulates with the other switch manipulation being effected by the biasing upon freeing of its actuating means from the carton side, said tie means being a rigid lever arm pivotally connected at one end to said switch unit.

21. An automatic position adjustable electrical circuit switch device comprising supporting means to be moved forward and back along a first path extending in a certain direction toward and away from a relatively fixed object, a movable switch unit, guiding means on said supporting means mounting said switch unit on the latter for reciprocation along a second path extending at an angle to the first path, switch manipulating trigger means extending from a side of said switch unit toward said object to contact the latter as said supporting means is advanced along the first path toward said object, and an elongated rigid tie member having one end pivotally connected to relatively fixed structure and its other end pivotally connected to said switch unit to cause the latter to advance along the second path as said supporting means is advanced along the first path and said switch unit to retract along the second path as said supporting means retracts along the first path.

22. In an automatic carton closing machine for folding down and inward the front, rear and opposed pair of side flaps of a series of successive open-top cartons of random size to closed lateral lapping positions for securing the folded flaps of each together in carton closing positions the combination with

(A) lateral conveyor means having an entrance end and a discharge end and defining a path of forward carton travel along which said conveyor means transports each carton to and past a sensing and flap folding station,

(B) a liftable gate mounted at the entrance end to permit entrance of a single carton when lowered and to be lifted to carton-barring position before approach thereto of the next succeeding carton of a supply thereof,

(C) first carton sensing means mounted in the vicinity of and beyond said gate,

(D) gate operating means including and electrical control circuit responsive to said sensing means to hold said gate down to permit entrance of a carton in the absence of a carton portion opposite said sensing means and to raise the latter to carton-barring position upon sensing of a portion of a carton by said sensing means temporarily to prevent entrance of the next successive carton,

(E) second carton sensing means at said sensing station responsive to the presence of a carton delivered to the latter by an initial section of said conveyor means,

(F) a flap folding elevating head mounted at said sensing station for motion down and up toward and away from the top of a carton held at said station having means to fold down the upwardly-extending front flap on the leading top end of the carton thereat when said head is lowered to the carton top,

(G) carton top sensing means in the form of electrical circuit limit switching means carried by said head having a plurality of simultaneously operable circuit switches,

(H) electrical means alternately to lower and lift said head controlled by said electrical carton top sensing limit switching means to stop the lowering action of said head at the carton top after the folding of the front flap thereby,

(I) a pair of opposed carton guiding and clamping rails mounted along the portion of the path of carton travel defined by said second conveyor section and extending through said station, said rails being movable transversely toward each other to carton clamping positions and retractable transversely away from each other to carton receptive positions,

(J) electrically energized means to drive said clamping rails toward each other to clamp a carton at said station therebetween and alternately to retract them from each other to free said carton,

(K) a control switch common to the electrical circuit of said clamping rail drive means and to the circuit of the electrical means for lowering said head with the latter circuit including in closed condition one of said switches of said head limit switching means to cause said clamping rails to be moved into clamping positions on opposite sides of the carton and the flap folding head to lower down over the top thereof,

(L) means to provide clearance between the clamping rails and the sides of the cartons so that said rails thereafter will serve as guides for the carton as it is carried forward to the discharge end,

(M) back flap folding means carried by said head to fold down the upwardly-extending flap on the trailing top end of the carton as the latter is transported forward from said sensing station while said head is in its lowered position, and

(N) electrically energized means to operate said back flap folding means,

of the improvements comprising

(a) a continuously driven endless conveyor section constituting an initial section of said conveyor means leading from said gate forward to the sensing and flap folding station and a second periodically driven endless section of said conveyor means extending from a point preceding said station to the discharge end with its entrance end lapping the discharge end of the continuously driven initial section,

(b) electrical means to drive said second conveyor section including alternately operable electrical brake and clutch devices which applies the brake to this conveyor section when the clutch is declutched and applies drive thereto through the clutch upon release of the brake,

(c) flight means carried by said second conveyor section to stop a carton at said sensing station when this conveyor section is undriven,

(d) a pair of alternately operable circuit make and break devices in energizing circuits of said head lowering and lifting electrical means controlled by said second carton sensing means at said sensing station alternately to dictate operation of this electrical means in response to the presence and absence of a carton at said station,

(e) the electrical circuit of said clamping rail drive means and the circuit of the electrical means for lowering said head both including one of said circuit make and break devices in open condition whereby the presence of a carton at said sensing station closes this circuit make and break device to cause said clamping rails to be moved into clamping positions on opposite sides of the carton and the flap folding head to lower down over the top thereof,

(f) limit switch means operated by said second conveyor section and having a plurality of simultaneously operable switches including said control switch,

(g) relay switch means controlling the electrical circuits of said alternately energized brake and clutch devices with said relay switch means having in its energizing circuit in open condition a second one of said switches of said head limit switching means to be closed when said head is lowered to the carton top to initiate drive of said second conveyor section,

(h) a second switch of said conveyor limit switch means being located in a holding circuit shunted around said second switch of said head limit switching means in the energizing circuit of said relay switch means and held open during undriven pause of said second conveyor section to be closed upon initial drive of the latter for transport of said carton from said sensing station forward between the guide rails,

(i) said control switch of said conveyor limit switch also being common to the circuit of the electrical means for lifting said head to its initial start position with this circuit including the other of said circuit make and break devices in closed position in the absence of a carton at said sensing station whereby after said head is lowered to the top of a carton at said sensing station during a pause of said second conveyor section in response to the presence of the carton thereat and this conveyor section becomes driven to transport the carton forward from said sensing station said head is lifted to its initial start position during a succeeding pause of this second conveyor section and before the next carton arrives at said sensing station,

(j) a third switch of said conveyor limit switch means being located in the electrical control circuit of said gate operating means in closed position during pause of said second conveyor section with this switch being open upon drive of the latter whereby said gate is lowered to its carton receptive position upon such pause and is then raised by response of said first carton sensing means to the presence of carton structure beyond said gate,

(k) a switch in the energizing circuit of said back flap folding means having a carton sensing control located at said sensing station with said control being mounted upon one of said clamping and guide rails whereby the presence of a clamped carton at said sensing station prevents said back flap folding means from being operated and the forward transport of the carton forward from said sensing station dictates operation of said back flap folding means to fold the back flap forward as the carton is withdrawn from said sensing station, and

(l) means carried by said head to fold side flaps of said carton top down over the folded front and back flaps as the carton is transported forward from said sensing station by said second conveyor section.

23. The automatic carton closing machine as defined in claim **22** characterized by said first carton sensing means associated with said gate and said second carton sensing means at said sensing station being in the form of photo cell systems optically to sense carton structure thereopposite, the sensing means mounted on said head and one of said rails at said sensing station being of mechanical types to respond physically to abutment of carton structure with that on said head sensing the height of each successive carton and that on one of said rails sensing the width of each carton.

24. The automatic carton closing machine as defined in claim 1 characterized by

(a) fixed machine frame means,

(b) a pair of opposed and elongated guide members extending along the carton travel path forward through said station with at least one thereof mounted for transverse movement relative to the other for varying their transverse separation,

(c) means for progressively moving transversely the movable one of said guide members between an outward position of relatively wide separation of said guide members for reception of an oncoming carton therebetween and in an inward position which effects substantial abutment of said guide members to opposite sides of a carton being transported by said conveyor means through the machine,

(d) said means for dictating activation of said rear flap folding means including control means movably carried by said transversely movable guide member for longitudinal adjustment along the latter, said control means having a carton-contacting actuator extending inward from said movable guide member into the carton travel path for control means operating abutment to a longitudinal wall of a carton when the latter is located between said guide members with these guide members abutted to opposite sides of this carton and when the latter is opposite said actuator, said actuator being freed from the carton wall abutting relation as the rear end of the abutted carton is withdrawn therebeyond, and

(e) operative means connected between a portion of said fixed frame means and said control means progressively to adjust the position of the latter longitudinally along its supporting guide member in one direction as the latter is moved progressively inward toward the opposed carton side and in the opposite direction as this guide member is moved progressively outward.

25. In an automatic carton closing machine for closing successively a series of random size cartons each having at its top and bottom a plurality of front and rear and side flaps adapted to be lapped together in carton-closing positions, said machine comprising fixed machine frame means, lateral carton conveyor means having an entrance end and a discharge end

and defining a path of forward carton travel along which said conveyor means transports each carton, and a carton closure effecting station located at a point along said path, wherein the improvement comprises

(*a*) *a pair of opposed and elongated guide members extending along the carton travel path forward through said station with at least one thereof mounted for transverse movement relative to the other for varying their transverse separation,*

(*b*) *means for progressively moving transversely one of said guide members between an outward position of relatively wide separation of said guide members for reception of an oncoming carton therebetween and an inward position which effects substantial abutment of said guide members to opposite sides of a carton being transported by said conveyor means through the machine,*

(*c*) *means for dictating a carton closing operation at said station in the form of control means movably carried by said transversely movable guide member for longitudinal adjustment along the latter,*

(*d*) *said means having a carton-contacting actuator extending inward from said movable guide member into the carbon travel path for control means operating abutment to a longitudinal wall of a carton when the latter is located between said guide members*

with these guide members abutted to opposite sides of this carton and when the latter is opposite said actuator, said actuator being freed from the carton wall abutting relation as the rear end of the abutted carton is withdrawn therebeyond, and

(*e*) *operative means connected between a portion of said fixed frame means and said control means progressively to adjust the position of the latter longitudinally along its supporting guide member in one direction as the latter is moved progressively inward toward the opposed carton side and in the opposite direction as this guide member is moved progressively outward.*

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Reissue No. 26,440 August 13, 1968

Winton Loveland et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 61, "flaps" should read -- flap --. Column 2, line 22, "with" should read -- which --; line 23, "automaticlly" should read -- automatically --. Column 3, line 32, after "view" insert a comma; line 39, "holding" should read -- folding --. Column 4, line 30, "This" should read -- The --; line 36, "bend" should read -- bed --; line 61, "suppled" should read -- supplied --. Column 6, line 24, after "in" insert -- the --; line 66, after "within" insert a comma. Column 7, line 33, after "bed" insert -- unit --. Column 11, line 39, "type" should read -- tape --. Column 13, line 19, "782" should read -- 182 --; line 18, "gearings" should read -- gearing --. Column 14, line 1, "ports" should read -- port --; line 25, after "through" insert -- to --. Column 16, line 16, before "effecting" insert -- in --; line 34, "recifier" should read -- rectifier --. Column 17, line 35, "its" should read -- it --. Column 18, line 17, after "relay" insert -- coil --. Column 20, line 13, "rcep-" should read -- recep- --; line 19, "passage" should read -- passages --. Column 21, line 38, "corton-barring" should read -- carton-barring --. Column 24, line 50, "holding" should read -- folding --; line 67, "actuator" should read -- attendant --. Column 25, line 73, after "permitted" insert -- to --. Column 28, line 38, "flaps" should read -- flap --. Column 29, line 49, "in" should read -- an --. Column 31, line 54, "manipulates" should read -- manipulations --. Column 32, line 21, "and" should read -- an --. Column 34, line 43, cancel "in". Column 35, line 23, "said means" should read -- said control means --; line 25, "carbon" should read -- carton --.

Signed and sealed this 13th day of January 1970.

(SEAL)
Attest:

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